United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with the Texas Agricultural Experiment Station, the Texas State Soil and Water Conservation Board, and the United States Forest Service

Soil Survey of Fannin County, Texas

How to Use This Soil Survey

General Soil Map

The general soil map, which is a color map, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

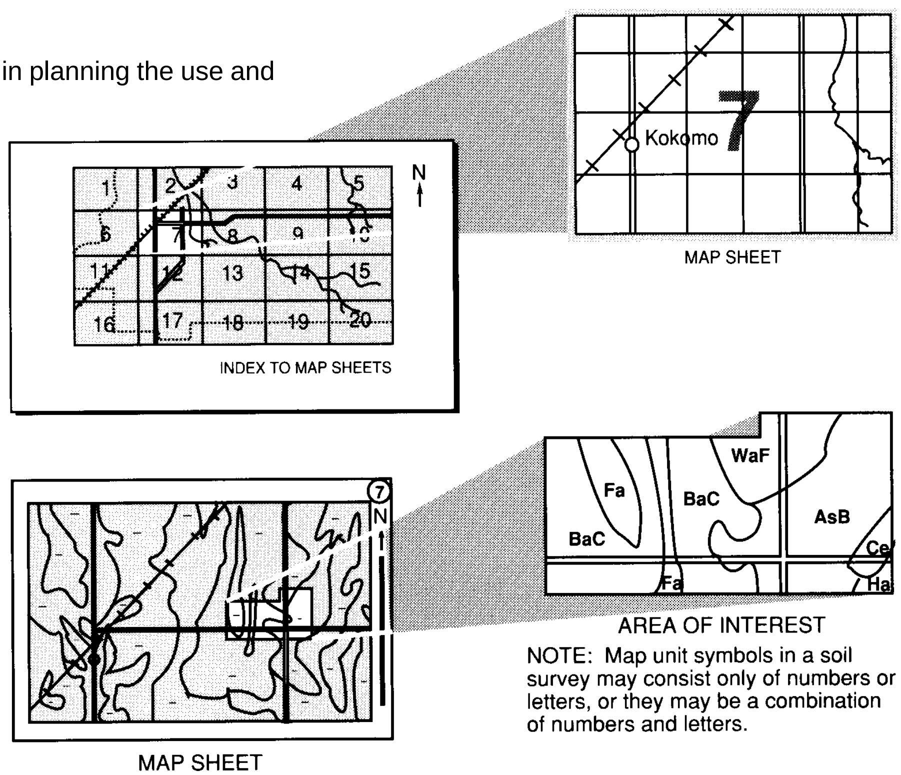
Detailed Soil Maps

The detailed soil maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.



This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1987. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Natural Resources Conservation Service, the Texas Agricultural Experiment Station, the Texas State Soil and Water Conservation Board, and the U.S. Forest Service. The survey is part of the technical assistance furnished to the Fannin Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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Cover: The Sam Rayburn Memorial Library in Bonham. "Mr. Sam" served in the U.S. Congress for 49 years and was Speaker of the House for a record 17 years.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

Contents

Issued 2001

Foreword

This soil survey contains information that can be used in land-planning programs in Fannin County, Texas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations that affect various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

John Burt
State Conservationist
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Soil Survey of Fannin County, Texas

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Fieldwork by A.R. Goerdel and Cathrine C. Sherwood, Natural Resources Conservation Service.

United States Department of Agriculture, Natural Resources Conservation Service
in cooperation with
the Texas Agricultural Experiment Station, the U.S. Forest Service, and the
Texas State Soil and Water Conservation Board

Fannin County is in the northeast part of Texas (fig. 1). It has an area of 575,916 acres, or about 900 square miles. It is bordered on the north by the Red River, which separates the county from Bryan County, Oklahoma; on the east by Lamar and Delta Counties; on the south by Hunt and Collin Counties; and on the west by Collin and Grayson Counties.

Fannin County is divided into three land resource areas with distinct differences in relief, drainage, soils, and vegetation. The southern part of the county is in the Blackland Prairie Land Resource Area, where the soils formed under prairie vegetation. The northwest part is in the East Cross Timbers Land Resource Area, where the soils formed under savannah vegetation. The northeast part is in the East Texas Timber Land Resource Area, where the soils formed under trees.

Slopes in Fannin County range from nearly level to moderately steep. Elevation ranges from 478 feet at the mouth of Bois d’Arc Creek and the Red River to 767 feet in the southwestern part of the county. Annual rainfall ranges from 41 inches in the western part of the county to 44 inches in the eastern part. Most of the streams in the county drain into the Red River. Caney and Bois d’Arc Creeks are the principal streams. A small portion of the surface water in the southwest part of the county drains into the Trinity River. The rest of the surface water in the county drains into the South, Middle, and North Sulphur Rivers.

The descriptions, names, and delineations of soils in this soil survey do not fully agree with those in surveys of adjacent counties. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in mapping intensity or in the extent of the soils in the counties.

The survey of Fannin County, Texas, includes areas of Bryan County, Oklahoma, south of the Red River. Areas of Fannin County, Texas, north of the Red River are included with the survey of Bryan County, Oklahoma.

This soil survey updates the survey of Fannin County published in 1946 (Templin et al., 1946). It provides additional information and has larger maps, which show the soils in greater detail.

General Nature of the Survey Area

The climate, history and settlement, agriculture and business, and natural resources of the county are briefly described in this section.

Climate

Prepared by the Natural Resources Conservation Service Climatic Data Access Facility, Portland, Oregon.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Bonham in the period 1961 to 1990. Table 2 shows probable dates for the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter, the average temperature is 44 degrees F and the average daily minimum temperature is 33 degrees F. The lowest temperature on record, which occurred at Bonham on December 18, 1910, is -5

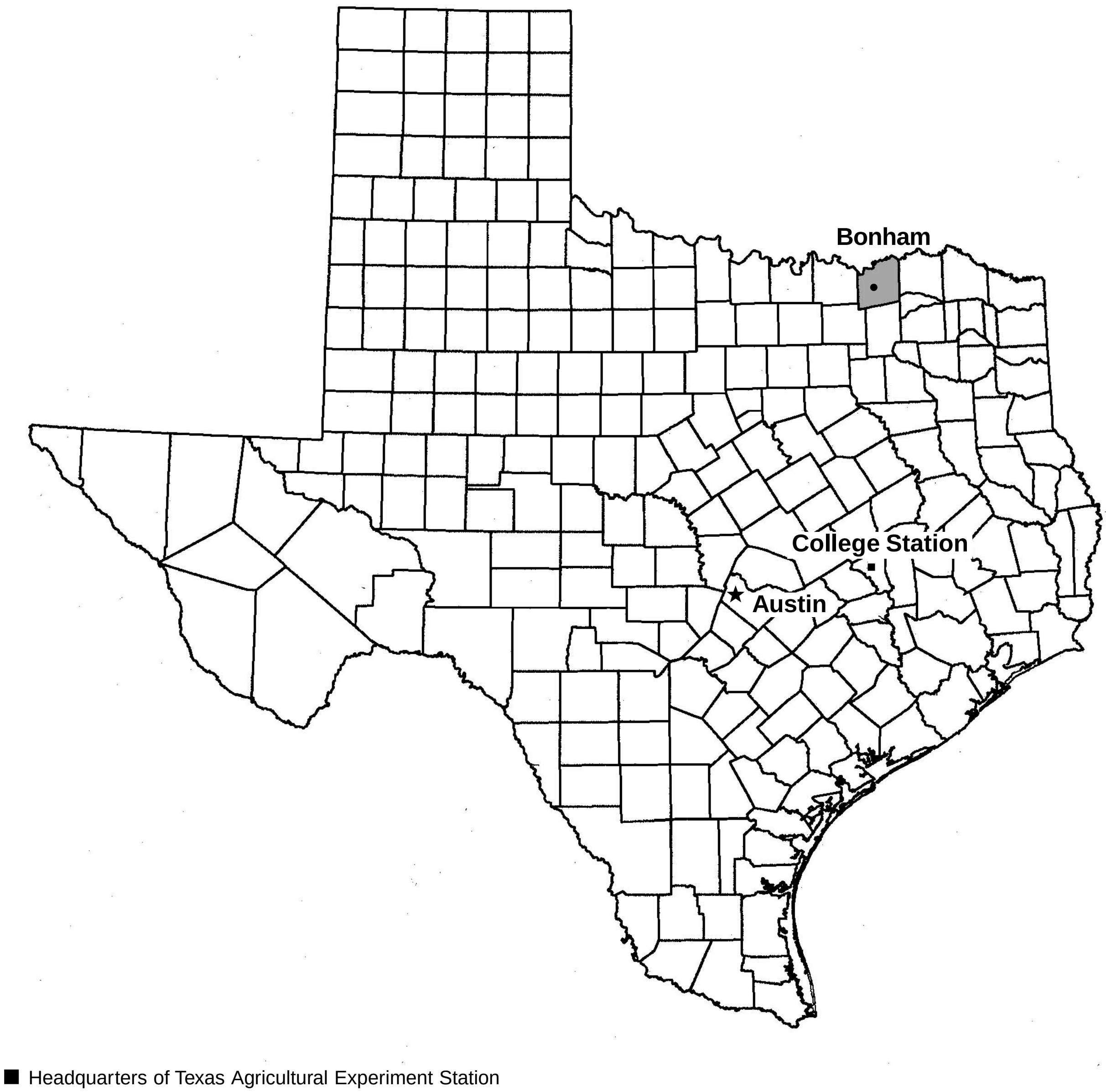

Figure 1.—Location of Fannin County in Texas.

degrees F. In summer the average temperature is 81 degrees F. The highest recorded temperature, which occurred at Bonham on August 10, 1936, is 115 degrees.

Growing degree days are shown in table 1. They are equivalent to “heat units.” During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 44 inches. Of this total, nearly 25 inches, or about 56 percent, usually falls from April through September. The growing season for most crops falls within this period. The heaviest recorded 1-day rainfall, which occurred at Bonham on July 30, 1903, is 13 inches. Thunderstorms occur on about 46 days each year; most occur in May.

Snowfall is rare. The average seasonal snowfall is about 3 inches. The greatest snow depth at any one time during the period of record was 7 inches. On an average of 1 day per year, at least 1 inch of snow is on the ground.

The average relative humidity in midafternoon is

about 56 percent. Humidity is higher at night, and the average at dawn is about 82 percent. The sun shines 74 percent of the time possible in summer and 56 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13 miles per hour, in March.

History and Settlement

Fannin County was formed by an act of the Congress of the Republic of Texas in 1837 or early 1839. The territory was taken from Red River County and included 20 of the present counties of Texas. Fannin County was named for James Walker Fannin, a hero of Texas independence.

The first county court was held at Jacob Black's place along the Red River in April of 1838. By an act of Congress in 1840, this court was moved to Warren, which is about 13 miles northwest of Bonham. Bois d'Arc was selected as the county seat in 1843. Congress also voted to change the name to Bloomington, but before the official documents arrived from the Capitol, Congress was petitioned to call the place Bonham in honor of James Butler Bonham, a soldier who lost his life at the Alamo.

Settlement started as early as 1826, at Rocky Ford, along Bois d'Arc Creek. In 1839, Fort Inglish was completed to protect the settlers of Bois d'Arc against Indian attacks. The fort was located within the present city limits of Bonham. Fort Warren was built in 1836, and Fort Lyday was built in the early 1800's.

In 1860, the population of the county was 9,217; in 1870, it was13,206; in 1880, it was 25,498; in 1885, it was estimated to be 35,000; and in 1985, it was 24,600. Bonham, the county seat, is the largest town. Other towns in the county include Bailey, Dodd City, Ector, Honey Grove, Ladonia, Leonard, Ravenna, Savoy, Trenton, and Windom.

Agriculture and Business

Agriculture is the main business in Fannin County. The major land uses are cropland and improved pasture. Nearly half of the agricultural income in the county is derived from the sale of livestock, primarily beef cattle. The livestock graze mainly on improved pastures. Bermudagrass and fescue are the main improved pasture grasses.

Important cash crops include wheat, grain sorghum, soybeans, corn, and peanuts (fig. 2). Cotton was once the main cash crop, but it is now grown on less than 2,000 acres in the county.

The county has several small manufacturing businesses. Most of these are located in Bonham.

Natural Resources

Soil is the most important natural resource in the county. Forage for livestock and food, fiber, and timber for marketing and for home consumption are produced on the soils in the county. These products are a major source of livelihood for many people.

Water is another important natural resource. Several lakes provide water for the towns as well as for recreation and fishing. Wells provide water for household use. A few wells provide water for irrigation. Many floodwater-retarding structures have been built in the northwest and southwest parts of the county.

Wildlife provides both recreational opportunities and income for landowners. Quail and dove are throughout the county. Deer and turkey are in the northeast part of the county.

There are a few gravel pits along the Red River. Chalk in the southern part of the county is used for road material.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, geomorphology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Figure 2.—Peanuts in an area of Crockett loam, 1 to 3 percent slopes.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of

management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Clayey and Loamy, Slightly Acid to Moderately Alkaline Soils on Uplands

These map units make up about 38 percent of the county. The major soils are Dalco, Fairlie, Ferris, Houston Black, Howe, Leson, and Whitewright. Ferris, Houston Black, and Leson soils are very deep. Fairlie soils are deep. Dalco and Howe soils are moderately deep. Whitewright soils are shallow. Fairlie soils are nearly level and gently sloping. Houston Black and Leson soils are very gently sloping. Dalco soils are gently sloping. Ferris, Howe, and Whitewright soils are gently sloping to strongly sloping.

The nearly level, very gently sloping, and gently sloping soils are used mainly for corn, wheat, and grain sorghum. Most areas of the moderately sloping to strongly sloping soils are used as rangeland.

The potential for shrinking and swelling with changes in moisture and a shallow or moderate depth to bedrock are limitations affecting most urban uses of these soils.

1. Fairlie-Dalco

Deep and moderately deep, nearly level to gently sloping, moderately alkaline, clayey soils

The landscape of this unit consists of broad, nearly level to very gently sloping areas that are dissected by a few drainageways. Slopes range from 0 to 3 percent.

This unit makes up about 17 percent of the county. It is about 50 percent Fairlie soils, 20 percent Dalco soils, and 30 percent other soils (fig. 3).

The surface layer of the Fairlie soils typically is black clay about 42 inches thick. The subsoil is very dark grayish brown clay about 12 inches thick. The substratum is white chalk.

The surface layer of the Dalco soils typically is black clay about 28 inches thick. The subsoil is very dark grayish brown clay about 8 inches thick. The substratum is white, platy chalk.

Other soils in this unit are the very deep Burleson, Frioton, and Wilson soils; the moderately deep Austin and Howe soils; and the shallow or very shallow Whitewright and Stephen soils. Austin soils are on low ridges. Burleson soils are on nearly level stream terraces. Frioton soils are on nearly level flood plains along creeks and drainageways. Howe soils are on the gently sloping lower side slopes adjacent to drainageways. Stephen soils are on gently sloping ridges and side slopes adjacent to drainageways. Whitewright soils are on the gently sloping to steep upper side slopes adjacent to drainageways. Wilson soils are on nearly level terraces associated with uplands.

The soils in this unit are used mainly as cropland. Corn, grain sorghum, and wheat are the main crops. These soils are suited to improved pasture and rangeland.

These soils shrink and swell with changes in moisture. The shrink-swell potential is a limitation when houses, streets, and roads are constructed. Very

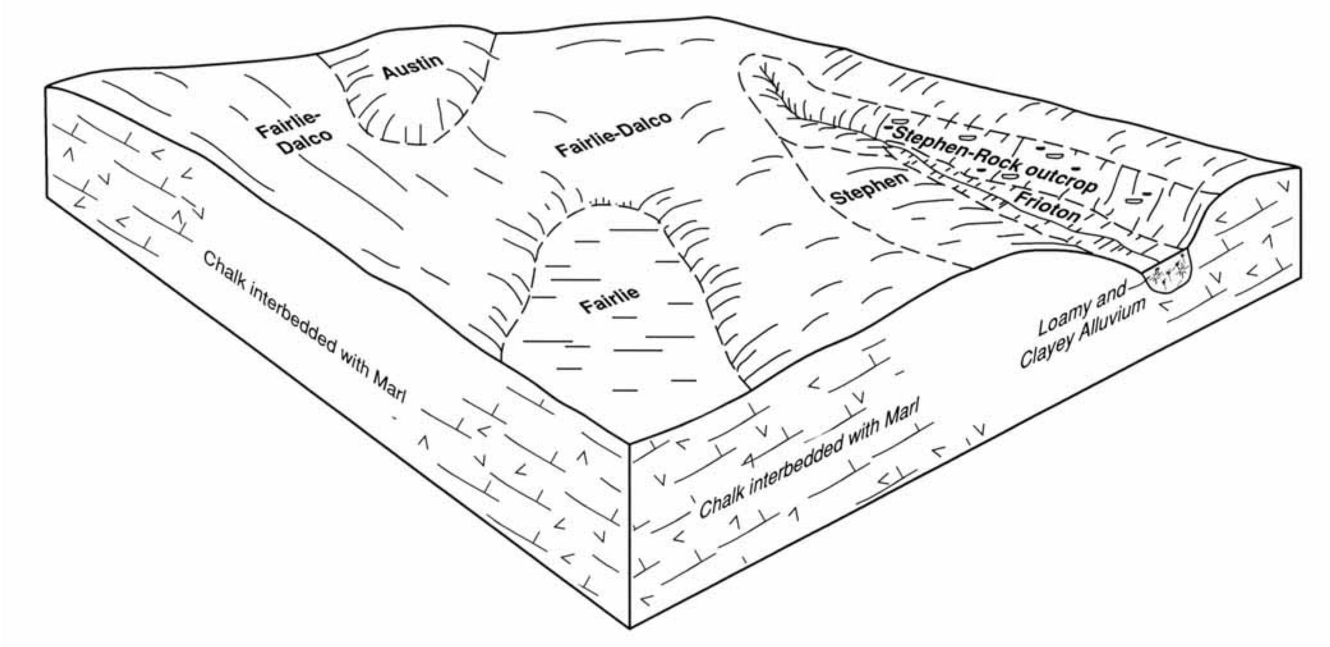

Figure 3.—Pattern of soils and parent material in the Fairlie-Dalco general soil map unit.

slow permeability is a limitation when septic tank absorption fields are installed.

2. Houston Black-Leson

Very deep, very gently sloping, slightly acid to moderately alkaline, clayey soils

This unit consists mainly of very gently sloping Houston Black and Leson soils. It is dissected by a few drainageways. Slopes range from 1 to 3 percent.

This unit makes up about 9 percent of the county. It is about 48 percent Houston Black soils, 22 percent Leson soils, and 30 percent other soils (fig. 4).

The surface layer of the Houston Black soils typically is black clay about 37 inches thick. The subsoil, from 37 to 75 inches, is very dark grayish brown clay with light olive brown and dark gray mottles. The substratum, to a depth of 80 inches, is dark yellowish brown clay with olive brown and dark gray mottles.

The surface layer of the Leson soils typically is black clay about 36 inches thick. It has yellowish brown mottles in the lower part. The upper part of the subsoil is very dark grayish brown clay about 12 inches thick. The lower part of the subsoil is mottled dark grayish brown and brown clay about 22 inches thick. The substratum, to a depth of 80 inches, is mottled brown and yellowish brown, stratified clay.

Other soils in this unit are the very deep Burleson, Ferris, Frioton, Heiden, Lamar, Lewisville, Tinn, and Wilson soils. Burleson and Wilson soils are on nearly level stream terraces. Ferris and Heiden soils are on the strongly sloping upper side slopes. Frioton and Tinn soils are on nearly level flood plains. Lamar soils are on moderately sloping hill slopes. Lewisville soils are on gently sloping, low ridges and hill slopes.

The soils in this unit are used mainly as cropland. Corn, grain sorghum, and wheat are the main crops. These soils are suited to improved pasture and rangeland.

These soils shrink and swell with changes in moisture. The shrink-swell potential is a limitation when houses, streets, and roads are constructed. Very slowly permeability is a limitation when septic tank absorption fields are installed.

3. Whitewright-Howe

Shallow and moderately deep, gently sloping to strongly sloping, moderately alkaline, loamy soils

The landscape of this unit consists of gently sloping to strongly sloping hillsides with gullies and eroded spots. Slopes range from 3 to 12 percent.

This unit makes up about 8 percent of the county. It is about 32 percent Whitewright soils, 21 percent Howe soils, and 47 percent other soils (fig. 5).

The surface layer of the Whitewright soils typically is dark grayish brown silty clay loam about 7 inches

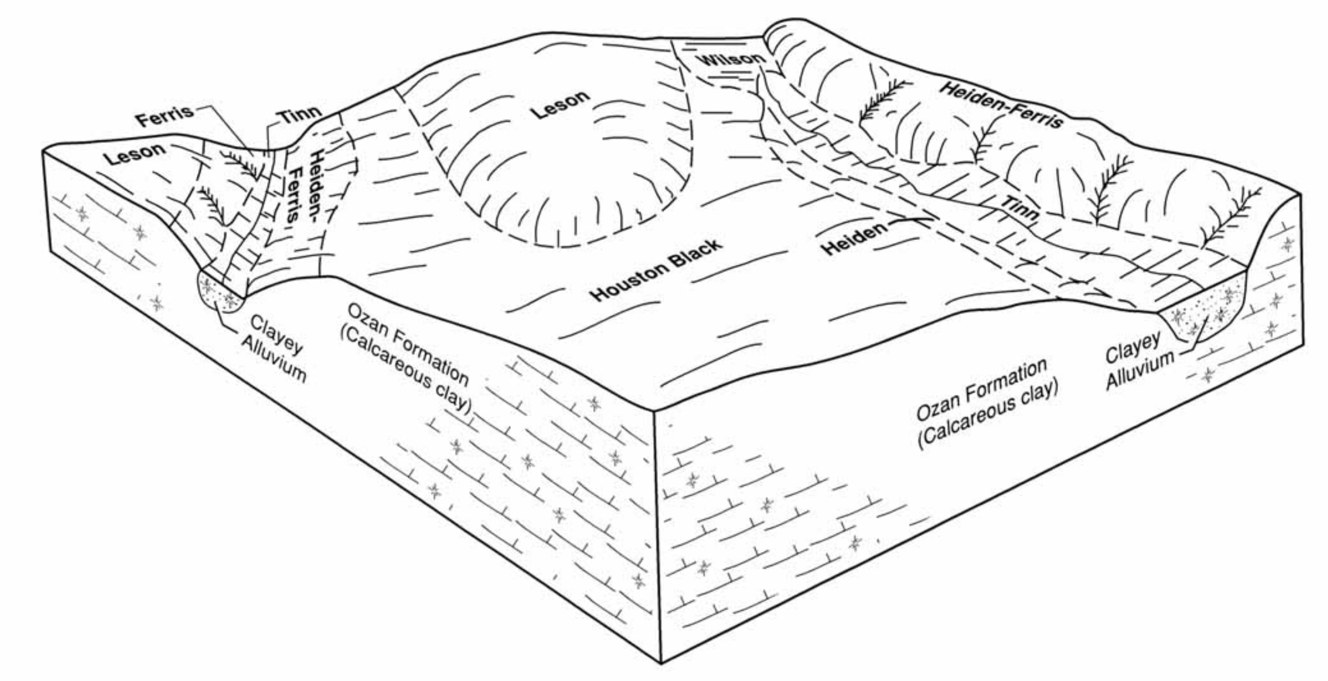

Figure 4.—Pattern of soils and parent material in the Houston Black-Leson general soil map unit.

thick. The subsoil is dark brown silty clay loam about 10 inches thick. The substratum is gray chalk.

The surface layer of the Howe soils typically is dark grayish brown clay loam about 8 inches thick. The upper part of the subsoil is grayish brown clay loam about 8 inches thick. The lower part of the subsoil is pale brown clay loam about 11 inches thick. The substratum is pale brown, brittle marl interbedded with chalk.

Other soils in this unit are the very deep Frioton, Lamar, and Lewisville soils; the deep Fairlie soils; and the moderately deep Austin and Dalco soils. Austin soils are on gently sloping ridges. Fairlie and Dalco soils are in broad, gently sloping areas. Frioton soils are on nearly level flood plains. Lamar soils are on moderately sloping hill slopes. Lewisville soils are on gently sloping hill slopes.

Most of this unit is used as rangeland. Some areas are used as improved pasture. The more sloping soils are not suitable for crops. A high content of lime can cause chlorosis in some crops.

The potential for shrinking and swelling with changes in moisture is a limitation when houses, streets, and roads are constructed. The slope can limit some urban uses. Depth to bedrock is a limitation when septic tank absorption fields are installed.

4. Ferris

Very deep, very gently sloping to strongly sloping, moderately alkaline, clayey soils

This unit makes up about 4 percent of the county. It is about 80 percent Ferris soils and 20 percent other soils. Slopes range from 2 to 12 percent.

The surface layer of the Ferris soils typically is dark olive gray clay about 6 inches thick. The subsoil is olive clay about 39 inches thick. The substratum, to a depth of 80 inches, is stratified olive and yellow shale with clay texture.

Other soils in this unit are the very deep Frioton, Heiden, Houston Black, Leson, and Tinn soils. Frioton and Tinn soils are on nearly level flood plains. Heiden, Houston Black, and Leson soils are on very gently sloping ridgetops and the lower side slopes.

Most of this unit is used as rangeland. The unit is not suitable as cropland because of the slope and a severe hazard of water erosion. Some areas are used as improved pasture.

The soils in this unit shrink and swell with changes in moisture. The shrink-swell potential is a limitation when houses, streets, and roads are constructed. Very slow permeability is a limitation when septic tank absorption fields are installed.

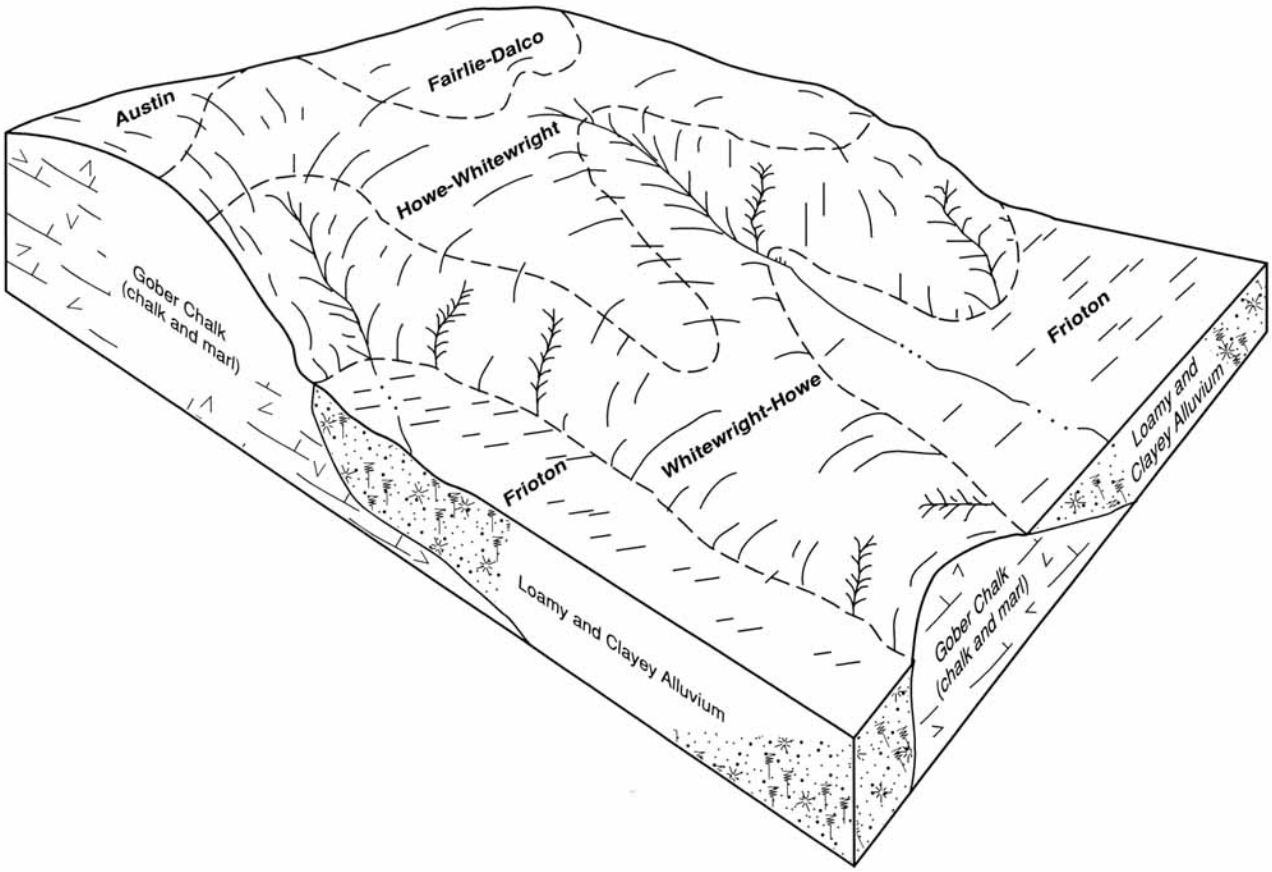

Figure 5.—Pattern of soils and parent material in the Whitewright-Howe general soil map unit.

Loamy, Very Strongly Acid to Neutral Soils on Terraces

The landscape of the Red River terrace system consists of four different levels (fig. 6).

These map units make up about 27 percent of the county. The major soils are Bastrop, Derly, Freestone, Ivanhoe, Karma, Porum, Whakana, and Wilson. All of these soils are very deep. Derly, Freestone, Ivanhoe, and Wilson soils are nearly level. Bastrop soils are gently sloping. Karma soils are nearly level to strongly sloping. Porum and Whakana soils are gently sloping to strongly sloping.

Most of the nearly level to gently sloping soils are cultivated. The main crops are grain sorghum, peanuts, soybeans, and wheat. The strongly sloping soils are used as native pasture.

The potential for shrinking and swelling with changes in moisture is a limitation affecting most urban uses of these soils.

5. Whakana-Porum-Freestone

Very deep, nearly level to strongly sloping, very strongly acid to neutral soils

This unit makes up about 12 percent of the county. It is about 38 percent Whakana soils, 23 percent Porum soils, 11 percent Freestone soils, and 28 percent other soils. Slopes range from 0 to 12 percent.

The surface layer of the Whakana soils typically is brown very fine sandy loam about 14 inches thick. The upper part of the subsoil is red sandy clay loam about 18 inches thick. The lower part of the subsoil, from 32 to 80 inches, is red sandy clay loam with vertical streaks of white sand.

The surface layer of the Porum soils typically is yellowish brown loam about 5 inches thick. The upper part of the subsoil is yellowish red clay loam about 11 inches thick. From 16 to 50 inches, the subsoil is mottled dark yellowish brown, grayish brown, gray, light gray, yellowish brown, and strong brown silty clay

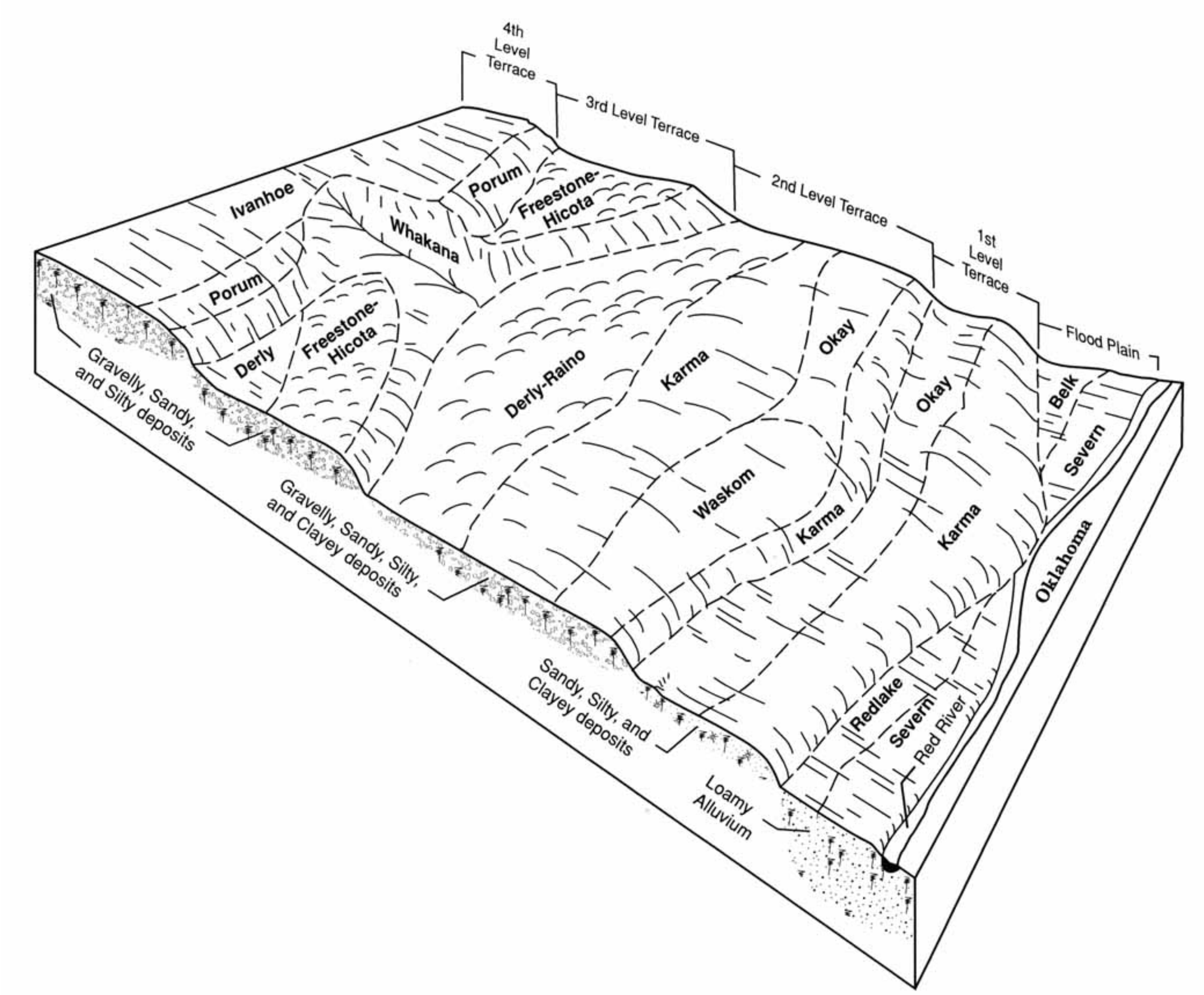

Figure 6.—Typical landscape pattern and major soils on terraces along the Red River.

loam. The lower part of the subsoil, to a depth of 80 inches, is mottled strong brown, brown, dusky red, and light gray clay loam.

The surface layer of the Freestone soils typically is dark yellowish brown loam about 5 inches thick. The subsurface layer is light yellowish brown loam about 5 inches thick. From 10 to 18 inches, the subsoil is strong brown loam with yellowish brown mottles; from 18 to 24 inches, it is strong brown sandy clay loam with red and gray mottles; from 24 to 30 inches, it is light gray clay loam with dark red and yellowish brown mottles and vertical streaks of fine sandy loam; from 44 to 58 inches, it is dark red clay loam with light gray mottles; and from 58 to 80 inches, it is red clay loam with brown mottles.

Other soils in this unit are the very deep Burleson, Dela, Elbon, Heiden, Hicota, and Morse soils and the moderately deep Aubrey soils. Aubrey soils are on gently sloping to moderately steep hillsides, mainly near Lake Fannin. Burleson soils are on broad, nearly level stream terraces. Dela and Elbon soils are on nearly level flood plains along drainageways and creeks. Heiden soils are on the very gently sloping upper side slopes of low ridges. Hicota soils are on gently sloping pimple mounds. Morse soils are on strongly sloping hill slopes.

This unit is mainly used as improved pasture. Bermudagrass and bahiagrass are the main grasses grown on the unit. Arrowleaf clover is grown in a mixture with these grasses in some areas. Grain

sorghum, peanuts, soybeans, and wheat are the main cultivated crops. Pine trees have been planted in a few areas.

The potential for shrinking and swelling with changes in moisture in the subsoil is a limitation affecting most urban uses. Moderate to slow permeability is a limitation when septic tank absorption fields are installed.

6. Karma-Derly

Very deep, nearly level to strongly sloping, strongly acid to slightly alkaline soils

This unit makes up about 7 percent of the county. It is about 41 percent Karma soils, 39 percent Derly soils, and 20 percent other soils. Slopes range from 0 to 12 percent.

The surface layer of the Karma soils typically is dark brown loam about 8 inches thick. The upper part of the subsoil is reddish brown sandy clay loam about 20 inches thick. The next part of the subsoil, to a depth of 44 inches, is yellowish red sandy clay loam. The lower part of the subsoil, to a depth of 80 inches, is yellowish red fine sandy loam.

The surface layer of the Derly soils typically is very dark grayish brown silt loam about 6 inches thick. The upper part of the subsoil is about 24 inches thick. It is dark gray clay with vertical streaks of gray silt loam in the upper 8 inches. The next part of the subsoil is dark gray clay loam with olive yellow mottles from 30 to 44 inches and gray clay loam with yellowish red mottles from 44 to 56 inches. The lower part of the subsoil, to a depth of 80 inches, is mottled light brownish gray and light olive brown clay loam.

Other soils in this unit are the very deep Dela, Elbon, Larton, Morse, Okay, Raino, and Waskom soils. Dela and Elbon soils are on nearly level flood plains along drainageways and small creeks. Larton soils are in nearly level to gently sloping areas, mainly around Monkstown. Morse soils are on strongly sloping hill slopes. Okay soils are in nearly level, slightly convex areas. Raino soils are on nearly level pimple mounds surrounded by Derly soils. Waskom soils are in nearly level areas.

The Karma soils are used mainly as cropland. Corn, grain sorghum, peanuts, and soybeans are the main cultivated crops. Most areas of the Derly soils are used as native pasture. Wetness is a limitation affecting these uses.

Low strength is a limitation when streets and roads are constructed on these soils. Corrosivity is a limitation affecting untreated concrete. Moderate to very slow permeability is a limitation when septic tank absorption fields are installed. Urban uses of the Derly soils are limited by wetness and by the potential for shrinking and swelling with changes in moisture in the subsoil.

7. Ivanhoe

Very deep, nearly level, slightly acid soils

This unit makes up about 7 percent of the county. It is about 77 percent Ivanhoe soils and 23 percent other soils.

The surface layer of the Ivanhoe soils typically is brown silt loam about 13 inches thick. It has reddish brown mottles in the lower part. The subsoil extends to a depth of 68 inches. From 13 to 17 inches, the subsoil is very dark grayish brown silty clay loam with reddish brown mottles; from 17 to 33 inches, it is very dark grayish brown clay with reddish brown mottles; from 33 to 51 inches, it is dark grayish brown clay; and from 51 to 68 inches, it is grayish brown clay with strong brown mottles. The substratum, to a depth of 84 inches, is light gray clay with strong brown mottles.

Other soils in this unit are the very deep Porum and Whakana soils. These soils are on the gently sloping to strongly sloping side slopes adjacent to drainageways.

Most of this unit is used as cropland or improved pasture. Wheat, grain sorghum, peanuts, and soybeans are the main cultivated crops. Coastal bermudagrass and common bermudagrass are the main pasture grasses.

The potential for shrinking and swelling with changes in moisture in the subsoil is a limitation when the foundations of buildings are designed and when streets and roads are constructed. Wetness and very slow permeability are limitations when septic tank absorption fields are installed.

8. Wilson-Bastrop

Very deep, nearly level to gently sloping, slightly acid soils

This unit makes up about 1 percent of the county. It is about 58 percent Wilson soils, 24 percent Bastrop soils, and 18 percent other soils. Slopes range from 0 to 5 percent.

The surface layer of the Wilson soils typically is very dark gray silt loam about 8 inches thick. The upper part of the subsoil is very dark gray silty clay about 16 inches thick. The next part of the subsoil is dark gray silty clay loam about 16 inches thick. The lower part of the subsoil, to a depth of 55 inches, is gray silty clay loam with brownish yellow mottles. The

substratum, to a depth of 80 inches, is light gray clay with brownish yellow mottles.

The surface layer of the Bastrop soils typically is dark brown loam about 11 inches thick. The upper part of the subsoil is dark red sandy clay loam about 18 inches thick. The next part of the subsoil is red sandy clay loam about 36 inches thick. The lower part of the subsoil, to a depth of 80 inches, is yellowish red loam.

Other soils in this unit are the very deep Bonham, Konawa, and Whitesboro soils; the moderately deep Birome soils; and Orthents. Birome soils are on gently sloping to strongly sloping ridges and low hills. Bonham soils are in very gently sloping and gently sloping, slightly convex areas. Konawa soils are on moderately sloping hill slopes. Whitesboro soils are on nearly level flood plains along small creeks. Orthents are in areas of reclaimed gravel pits.

Most areas of this unit are used as cropland. Wheat, grain sorghum, and forage sorghum are the main crops.

Low strength is a limitation when roads and streets are constructed on these soils. Corrosivity to unprotected steel and concrete is a limitation. The potential for shrinking and swelling with changes in moisture in the subsoil of the Wilson soils is a limitation when the foundations of buildings are designed and when streets and roads are constructed. Very slow permeability is a limitation when septic tank absorption fields are installed in the Wilson soils.

Loamy and Clayey, Moderately Acid to Neutral Soils on Uplands

These map units make up about 24 percent of the county. The major soils are Birome, Bonham, Crockett, Crosstell, Ellis, Normangee, and Wilson. Bonham, Crockett, Crosstell, Ellis, Normangee, and Wilson soils are very deep and are nearly level to gently sloping. Birome soils are moderately deep and are gently sloping to strongly sloping.

The very deep, nearly level to gently sloping soils are used mainly as improved pasture or cropland. Wheat, grain sorghum, and forage sorghum are the main crops. Coastal bermudagrass is the main grass grown in improved pastures. Some areas are used as rangeland.

Most of these soils shrink and swell with changes in moisture. The shrink-swell potential is a limitation when houses, streets, and roads are constructed. Slow or very slow permeability is a limitation when septic tank absorption fields are installed.

9. Normangee-Wilson-Bonham

Very deep, nearly level to gently sloping, slightly acid to neutral, loamy soils

This unit consists mainly of nearly level Wilson soils and very gently sloping and gently sloping Bonham and Normangee soils. Slopes range from 0 to 5 percent.

This unit makes up about 16 percent of the county. It is about 24 percent Normangee soils, 20 percent Wilson soils, 12 percent Bonham soils, and 44 percent other soils.

The surface layer of the Normangee soils typically is dark grayish brown clay loam about 6 inches thick. The subsoil is about 49 inches thick. The upper part of the subsoil is dark brown clay with reddish brown and dark grayish brown mottles. The next part of the subsoil is dark brown clay with dark yellowish brown, reddish brown, and yellowish red mottles. The lower part of the subsoil is mottled olive yellow, dark olive gray, gray, and reddish brown clay. The substratum, to a depth of 80 inches, is olive gray clay with light olive brown and yellowish brown mottles.

The surface layer of the Wilson soils typically is very dark gray silt loam about 8 inches thick. The upper part of the subsoil is very dark gray silty clay about 16 inches thick. The next part of the subsoil is dark gray silty clay loam about 16 inches thick. The lower part of the subsoil is gray silty clay loam with brownish yellow mottles. It is about 15 inches thick. The substratum, to a depth of 80 inches, is light gray clay with brownish yellow mottles.

The surface layer of the Bonham soils typically is very dark grayish brown silt loam about 10 inches thick. From 10 to 17 inches, the subsoil, is very dark grayish brown silty clay loam with brown mottles; from 17 to 30 inches, it is dark grayish brown silty clay with strong brown mottles; from 30 to 42 inches, it is mottled light olive brown and yellowish brown silty clay; from 42 to 56 inches, it is olive brown silty clay with yellowish brown and pale yellow mottles; and from 56 to 65 inches, it is grayish brown silty clay with gray, dark yellowish brown, and strong brown mottles. The substratum, to a depth of 80 inches, is light olive gray silty clay with yellow mottles.

Other soils in this unit are the very deep Burleson, Crockett, Elbon, Frioton, Heiden, Hopco, and Tinn soils and the moderately deep Aubrey, Stephenville, and Vertel soils. Aubrey soils are on the gently sloping to moderately steep lower side slopes and ridges. Burleson soils are on nearly level stream terraces. Crockett soils are on very gently sloping and gently sloping, low ridges. Elbon, Frioton, Hopco, and Tinn

soils are on nearly level flood plains along small creeks and drainageways. Heiden soils are on very gently sloping side slopes. Stephenville soils are on very gently sloping ridges and the upper side slopes. Vertel soils are on gently sloping and moderately sloping ridges.

The soils in this unit are used mainly as cropland or improved pasture. Wheat, grain sorghum, and forage sorghum are the main crops. Bermudagrass is the main pasture grass.

These soils have a subsoil that shrinks and swells with changes in moisture. The shrink-swell potential is a limitation when houses, streets, and roads are constructed. Very slow permeability is a limitation when septic tank absorption fields are installed.

10. Crockett

Very deep, very gently sloping and gently sloping, slightly acid, loamy soils

This unit consists of Crockett soils in very gently sloping and gently sloping areas and other soils in nearly level areas. It is dissected by a few drainageways. Slopes range from 1 to 5 percent.

This unit makes up about 4 percent of the county. It is about 60 percent Crockett soils and 40 percent other soils (fig. 7).

The surface layer of the Crockett soils typically is dark brown loam about 8 inches thick. The upper part of the subsoil is mottled dark brown and dark reddish brown clay about 10 inches thick. The lower part of the subsoil, to a depth of 65 inches, is mottled dark olive gray, olive brown, yellowish brown, dark olive, olive yellow, and gray clay. The substratum, to a depth of 80 inches, is mottled gray and light olive brown clay loam.

Other soils in this unit are the very deep Hopco, Lamar, and Wilson soils. Hopco soils are in nearly level areas on flood plains along drainageways and small creeks. Lamar soils are in moderately sloping areas on hill slopes between uplands and flood plains. Wilson soils are in nearly level areas on broad uplands.

This unit is used mainly as improved pasture. Bermudagrass is the main grass grown on the unit. Cultivated crops are grown in some areas. These soils are droughty in the summer months, and erosion-control measures are needed when the soils are cultivated.

These soils shrink and swell with changes in moisture. The shrink-swell potential is a limitation when houses, streets, and roads are constructed. Very slow permeability is a limitation when septic tank absorption fields are installed.

11. Ellis-Crockett

Very deep, very gently sloping to strongly sloping, slightly acid and neutral, clayey and loamy soils

This unit makes up about 2 percent of the county. It is about 47 percent Ellis soils, 11 percent Crockett soils, and 42 percent other soils. Slopes range from 1 to 12 percent.

The surface layer of the Ellis soils typically is dark grayish brown clay about 4 inches thick. The upper part of the subsoil is dark olive gray clay about 14 inches thick. The lower part of the subsoil is mottled olive and olive brown clay about 12 inches thick. The substratum, to a depth of 66 inches, is light brownish gray clay with olive yellow streaks.

The surface layer of the Crockett soils typically is dark brown loam about 8 inches thick. The upper part of the subsoil is mottled dark brown and dark reddish brown clay about 10 inches thick. The lower part of the subsoil, to a depth of 65 inches, is mottled olive gray, olive brown, yellowish brown, olive, olive yellow, and gray clay. The substratum, to a depth of 80 inches, is mottled gray and light olive brown clay loam.

Other soils in this unit are the very deep Ferris, Frioton, Hopco, Houston Black, Leson, Normangee, Porum, Tinn, and Whakana soils. Frioton, Hopco, and Tinn soils are in nearly level areas on flood plains along drainageways and creeks. Ferris soils are in strongly sloping areas on side slopes along drainageways. Houston Black and Leson soils are in gently sloping areas on broad ridgetops. Normangee soils are in very gently sloping areas on the side slopes of low ridges. Porum and Whakana soils are in gently sloping to strongly sloping areas on narrow stream terraces.

This unit is used mainly as rangeland. Most areas of these soils were once cultivated, eroded, and abandoned. Generally, low-quality grasses are growing in these areas. In most areas the soils are unsuitable for cultivated crops because of a severe hazard of water erosion.

The potential for shrinking and swelling with changes in moisture is a limitation when the foundations of buildings are designed and when streets and roads are constructed. Very slow permeability is a limitation when septic tank absorption fields are installed.

12. Crosstell-Birome

Very deep and moderately deep, gently sloping to strongly sloping, moderately acid and slightly acid, loamy soils

This unit makes up about 2 percent of the county. It is about 54 percent Crosstell soils, 31 percent Birome

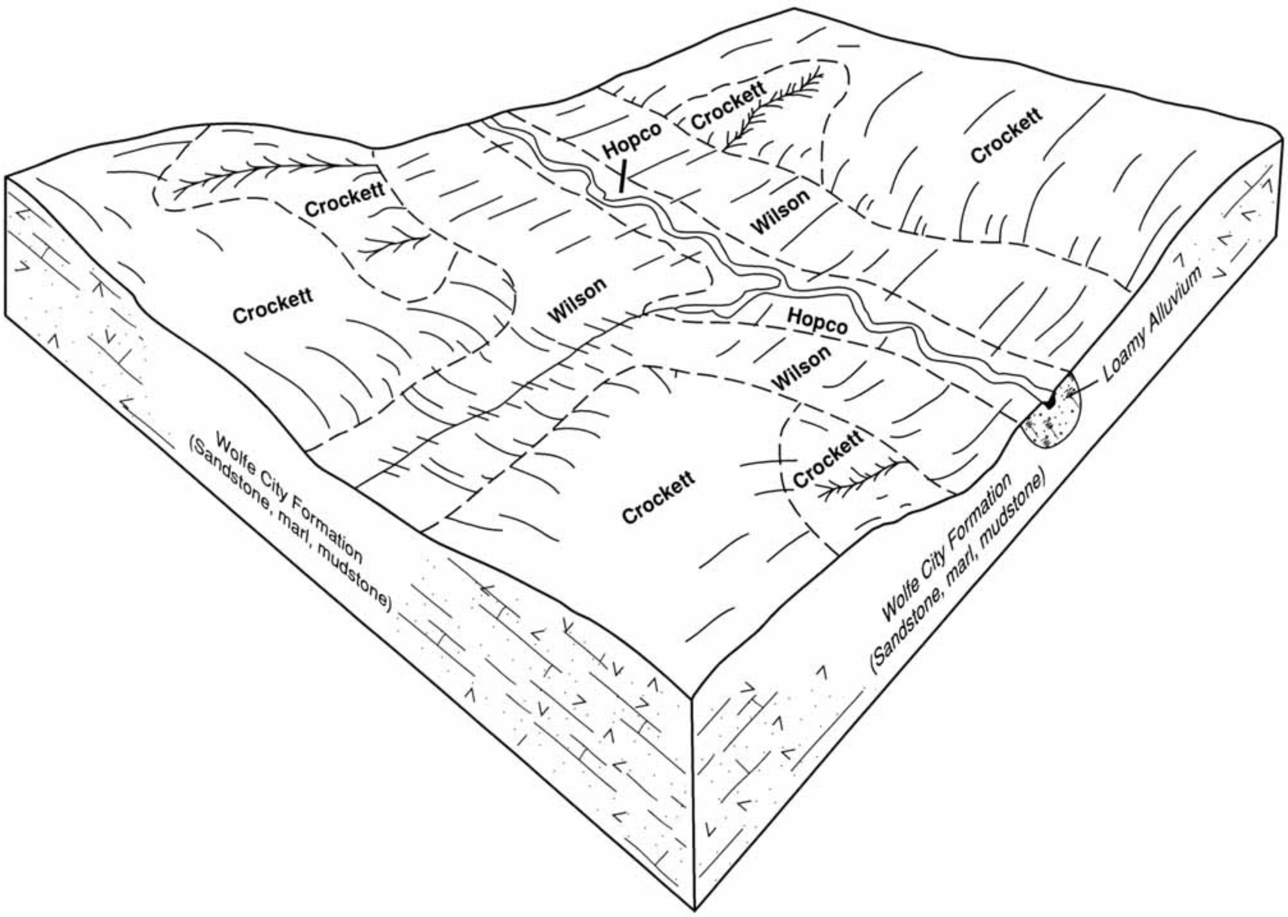

Figure 7.—Pattern of soils and parent material in the Crockett general soil map unit.

soils, and 15 percent other soils. Slopes range from 2 to 12 percent.

The surface layer of the Crosstell soils typically is very dark grayish brown fine sandy loam about 6 inches thick. The upper part of the subsoil is yellowish red clay about 18 inches thick. The lower part of the subsoil is dark brown clay about 20 inches thick. The substratum, to a depth of 60 inches, is yellowish red clay.

The surface layer of the Birome soils typically is dark brown fine sandy loam about 4 inches thick. The upper part of the subsoil, from 4 to 21 inches, is reddish brown sandy clay. The lower part of the subsoil, to a depth of 36 inches, is red sandy clay with light brownish gray, dark grayish brown, and brownish yellow mottles. The substratum, to a depth of 46 inches, is mottled red and pale brown, weakly cemented sandstone interbedded with shale material.

Other soils in this unit are the very deep Crockett, Normangee, and Whitesboro soils. Crockett soils are in very gently sloping areas on broad ridges. Normangee soils are in very gently sloping and gently sloping areas on the side slopes of low ridges. Whitesboro soils are in nearly level areas on flood plains along small creeks.

Most areas of this unit are used as rangeland. The vegetation consists of a post oak-blackjack oak savannah. The woody overstory shades about 20 percent of the ground.

The subsoil of these soils shrinks and swells with changes in moisture. The shrink-swell potential is a limitation when the foundations of buildings are designed and when streets and roads are constructed. Slow or very slow permeability is a limitation when septic tank absorption fields are installed.

Clayey and Loamy, Moderately Alkaline Soils on Flood Plains

These map units make up about 11 percent of the county. The major soils are Belk, Frioton, Redlake, Severn, and Tinn. These soils are very deep. Belk, Redlake, and Severn soils are rarely flooded; Frioton soils are occasionally flooded; and Tinn soils are occasionally flooded or frequently flooded.

The rarely flooded and occasionally flooded soils are used mainly as cropland. The frequently flooded soils are used mainly as native pasture but in a few areas are used as improved pasture.

Because of the hazard of flooding, these soils are unsuitable for most urban uses.

13. Tinn

Very deep, nearly level, clayey soils

This unit makes up about 5 percent of the county. It is about 85 percent Tinn soils and 15 percent other soils.

The surface layer of the Tinn soils typically is black clay to a depth of 8 inches and very dark gray clay from a depth of 8 to 46 inches. The subsoil, to a depth of 80 inches, is dark gray clay.

Other soils in this unit are the very deep, nearly level Benklin, Dela, Elbon, Frioton, Hopco, and Wilson soils. Dela, Elbon, and Hopco soils are near the mouths of small creeks, and Frioton soils are near the mouths of the larger creeks. Benklin and Wilson soils are on low terraces adjacent to flood plains.

The occasionally flooded soils are used mainly as cropland. The frequently flooded soils generally are used as native pasture but in a few areas are used as improved pasture.

This unit is unsuitable for urban uses because of the hazard of flooding.

14. Frioton

Very deep, nearly level, loamy soils

This unit makes up about 3 percent of the county. It is about 90 percent Frioton soils and 10 percent other soils.

The surface layer of the Frioton soils typically is very dark brown silty clay loam about 8 inches thick. The next 16 inches is very dark grayish brown silty clay loam. Below this, to a depth of 60 inches, is black silty clay. The substratum is very dark gray silty clay from a depth of 60 to 70 inches and dark grayish brown silty clay loam from a depth of 70 to 80 inches.

Other soils in this unit are the very deep Hopco, Lewisville, and Tinn soils. Hopco soils are in nearly level areas near the mouths of drainageways and small creeks. Lewisville soils are on very gently sloping, low ridges. Tinn soils are near creek channels.

This unit is used mainly as cropland. Corn, grain sorghum, and wheat are the main crops.

This unit is unsuitable for urban uses because of the hazard of flooding.

15. Severn-Belk-Redlake

Very deep, nearly level, loamy and clayey soils

This unit makes up about 3 percent of the county. It is about 22 percent Severn soils, 17 percent Belk soils, 16 percent Redlake soils, and 45 percent other soils.

The surface layer of the Severn soils typically is reddish brown silt loam about 7 inches thick. From 7 to 24 inches, the underlying material is reddish brown silt loam, and from 24 to 60 inches, it is reddish brown, stratified very fine sandy loam and fine sandy loam.

The surface layer of the Belk soils typically is dark reddish brown clay about 6 inches thick. The subsoil is reddish brown clay about 21 inches thick. The substratum, to a depth of 60 inches, is yellowish red silt loam.

The surface layer of the Redlake soils typically is dark reddish brown clay about 6 inches thick. The subsoil is clay that is dark reddish brown from 6 to 30 inches and reddish brown from 30 to 55 inches. The substratum, to a depth of 80 inches, is yellowish red clay loam.

Other soils in this unit are the very deep Karma, Kiomatia, Muldrow, Norwood, Okay, and Oklared soils. Karma and Okay soils are on the slightly higher, nearly level terraces adjacent to flood plains. Kiomatia and Oklared soils are in nearly level to gently undulating areas adjacent to the Red River channel. Muldrow soils are in nearly level, narrow, concave areas on the slightly higher terraces. Norwood soils are in nearly level areas adjacent to the larger streams that flow into the river.

Nearly all of this unit is cultivated. Corn, grain sorghum, soybeans, and wheat are the main crops. Peanuts are grown in some areas of the Severn soils.

The hazard of flooding limits most kinds of urban development on the soils in this unit.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given under the heading “Use and Management of the Soils.”

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some “included” areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Bonham silt loam, 1 to 3 percent slopes, is a phase of the Bonham series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes. A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Fairlie-Dalco complex, 1 to 3 percent slopes, is an example.

Table 4 gives the acreage and proportionate extent

of each map unit. Other tables give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

AbC—Aubrey loam, 2 to 6 percent slopes

This moderately deep, gently sloping soil is on upland ridges and the lower side slopes. The surface is convex. Areas range from 20 to 50 acres in size.

Typical Profile

Surface layer:
0 to 6 inches, very dark grayish brown loam

Subsoil:
6 to 15 inches, dark reddish brown clay
15 to 29 inches, dark red and dark gray clay
29 to 37 inches, dark red clay intermingled with dark gray shale

Substratum:
37 to 45 inches, dark gray shale with clay texture

Important Soil Properties

Available water capacity: low
Permeability: slow
Drainage class: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: moderately acid to neutral in the surface layer, strongly acid to slightly acid in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Stephenville and Vertel soils. Stephenville soils are on the very gently sloping upper side slopes and low ridges, and are underlain by sandstone. Vertel soils are on gently sloping and moderately sloping ridges and are clayey throughout.

Areas of this soil are used mainly as rangeland. The climax plant community is a post oak and blackjack oak savannah with an understory of paspalums, panicums, little bluestem, Virginia wildrye, and threeawn grasses. Forage production is limited by low natural fertility, the strongly acid reaction, and the low available water capacity. Root growth of deeply rooted plants is restricted by the dense shale substratum. A management program that includes proper grazing use or planned grazing systems helps to maintain productivity and plant vigor.

Some areas of this soil are used as improved pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, yellow bluestems, lovegrass, switchgrass, and indiangrass are suitable improved pasture species. These grasses may be overseeded with legumes, such as arrowleaf, ball, crimson, hop, and white clovers as well as lespedeza, singletary peas, and vetch, in order to produce additional forage and add nitrogen to the soil. Forage production is limited by low natural fertility, the strongly acid reaction, and the low available water capacity. The dense subsoil restricts root growth. A management program that includes applications of fertilizer and lime, controlled grazing, and weed control helps to maintain forage production.

Cultivated crops are grown in a few areas of this soil. Small grain and forage sorghum are suitable for planting. Applications of fertilizer and lime are needed for optimum crop production. Crop residue management helps to maintain soil tilth and control water erosion. Terracing also helps to control erosion.

This soil has several limitations that affect urban uses. The moderate potential for shrinking and swelling of the subsoil with changes in moisture is a limitation which must be considered when the foundations of buildings are designed and when the construction of streets and roads is planned. Low strength is an additional limitation when streets and roads are constructed. Slow permeability and the depth to dense shale can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Aubrey soil is in capability subclass IIIe and in the Tight Sandy Loam range site.

AbE—Aubrey fine sandy loam, 8 to 20 percent slopes

This moderately deep, strongly sloping to moderately steep soil is on upland ridges and side slopes. The surface is convex.

Typical Profile

Surface layer:
0 to 4 inches, brown fine sandy loam

Subsoil:
4 to 12 inches, mottled dark brown and reddish brown clay
12 to 32 inches, mottled strong brown, grayish brown, and brown clay

Substratum:
32 to 40 inches, dark gray shale

Important Soil Properties

Available water capacity: low
Permeability: slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: moderately acid to neutral in the surface layer, strongly acid to slightly acid in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are areas of Stephenville soils. These soils are on narrow, very gently sloping ridgetops and are underlain by sandstone. Also included are small areas with gullies that have eroded into the substratum, as well as small areas where the surface layer has been removed by sheet erosion.

This soil is used mainly as rangeland. The native climax vegetation consists of a post oak and blackjack oak savannah with an understory of tall and mid grasses. Forage production is limited by low natural fertility, the strongly acid reaction, and the low available water capacity. Root growth of deeply rooted plants is restricted by the dense shale substratum. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is poorly suited to cultivation. The slope, the severe hazard of water erosion, and the low available water capacity are limitations.

This soil is not used as improved pasture. The severe hazard of water erosion and the low available water capacity are the main limitations affecting the establishment of grasses.

This soil has several limitations that affect urban uses. The moderate potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. The slope also can be a limitation on building sites. Low strength is a limitation when streets and roads are constructed. Slow permeability and the depth to dense shale can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Aubrey soil is in capability subclass VIe and in the Tight Sandy Loam range site.

AuB—Austin silty clay loam, 1 to 3 percent slopes

This moderately deep, very gently sloping soil is on upland ridges. Areas are oval or long and narrow and range from 10 to 150 acres in size. The surface is convex.

Typical Profile

Surface layer:
0 to 7 inches, very dark brown silty clay loam
7 to 15 inches, very dark brown silty clay

Subsoil:
15 to 26 inches, dark grayish brown silty clay
26 to 30 inches, dark grayish brown silty clay with masses of calcium carbonate and chalk fragments

Substratum:
30 to 36 inches, white, platy chalk

Important Soil Properties

Available water capacity: low
Permeability: moderately slow
Drainage class: well drained
Runoff: low
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: moderately alkaline
Shrink-swell potential: high in the surface layer and moderate in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are areas of Howe, Stephen, and Whitewright soils. Howe soils are on the gently sloping lower side slopes adjacent to drainageways and have a light brownish gray surface layer. Stephen soils are in gently sloping areas adjacent to drainageways and are shallow to bedrock. Whitewright soils are on the gently sloping upper side slopes, have a light brownish gray surface layer, and are shallow to bedrock.

This soil is used mainly as cropland; wheat and grain sorghum are the main crops. Crop rotation is important for control of weeds, insects, and disease. Yields are limited by the low available water capacity. A high content of calcium carbonate causes chlorosis in some plants. Leaving crop residue on or near the soil surface helps to control erosion, conserve moisture, and maintain soil tilth and productivity. Terraces with grassed waterways and contour farming also help to control erosion (fig. 8). Applications of fertilizer increase yields.

Figure 8.—A parallel terrace system on Austin silty clay loam, 1 to 3 percent slopes, and Fairlie-Dalco complex, 1 to 3 percent slopes.

Many areas are used as improved pasture. Common bermudagrass and coastal bermudagrass are the main forage species. Introduced bluestems, fescue, Kleingrass, lovegrass, switchgrass, and indiangrass also are suitable improved pasture species. Legumes, such as black medic, arrowleaf, bur, button, red, and white clovers as well as vetch and singletary peas, produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Yields are limited by the low available water capacity. Proper grazing management and weed control help to maintain productivity, soil tilth, and the ground cover.

A few areas of this soil are used as rangeland. The potential plant community is a tall and mid grass prairie with about 5 percent woody canopy. The predominant grasses include little bluestem, indiangrass, big bluestem, and sideoats grama. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The moderate potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. Moderately slow permeability and the depth to bedrock can interfere

with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Austin soil is in capability subclass IIIe and in the Clay Loam range site.

BaC—Bastrop loam, 2 to 5 percent slopes

This very deep, gently sloping soil is on the second terrace level of the Red River, in the northwest part of the county. The surface is convex. Areas are irregular in shape and range in size from 10 to 900 acres. The average slope is 3 percent.

Typical Profile

Surface layer:
0 to 11 inches, dark brown loam

Subsoil:
11 to 29 inches, dark red sandy clay loam
29 to 65 inches, red sandy clay loam
65 to 80 inches, yellowish red loam

Important Soil Properties

Available water capacity: high
Permeability: moderate
Drainage class: well drained
Runoff: low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid to neutral in the surface layer and in the upper part of the subsoil, slightly acid to slightly alkaline in the lower part of the subsoil
Shrink-swell potential: low
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of the similar, moderately sloping Konawa soils.

Areas of this soil are used mainly as improved pasture and rangeland. Coastal bermudagrass is the most common pasture grass. Other suitable grasses include weeping lovegrass and bahiagrass. Pastures overseeded with arrowleaf clover, crimson clover, or vetch produce additional winter forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

The climax plant community is a post oak-blackjack oak savannah with an understory of tall and mid grasses. The woody overstory shades about 20 percent of the ground. The predominant grasses include little bluestem, indiangrass, switchgrass, purpletop, sideoats grama, and fall witchgrass. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas are used as cropland. In cultivated areas terraces with grassed outlets and contour farming are needed to control water erosion. Crop residue left on or near the soil surface improves soil tilth and productivity. Applications of fertilizer will increase yields. Additions of lime may be needed to correct soil acidity.

Most characteristics of this soil are favorable for building sites. This soil has only a few limitations that affect urban uses. Low strength is a limitation when streets and roads are constructed. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Bastrop soil is in capability subclass IIIe and in the Sandy Loam range site.

Be—Belk clay, rarely flooded

This very deep, nearly level soil is in broad areas on the flood plain along the Red River. This soil has not been flooded since the construction of Lake Texoma in the 1940's. Areas mainly are oblong and range in size from 50 to 500 acres. The surface is slightly concave. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 6 inches, dark reddish brown clay

Subsoil:
6 to 27 inches, reddish brown clay

Substratum:
27 to 60 inches, yellowish red silt loam

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: well drained
Runoff: low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: high in the surface layer and subsoil, low in the substratum
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Norwood, Redlake, and Severn soils. Redlake soils are clayey to a depth of more than 60 inches. Severn

and Norwood soils are on the long, narrow, slightly higher ridges. Also included are a few small areas of occasionally flooded Belk soils in the lower positions near the river channel.

This soil is used mainly as cropland; grain sorghum and soybeans are the main crops grown. Wheat and alfalfa are grown in a few areas. Growing soil-improving crops and leaving crop residue on or near the soil surface improve soil tilth. Applications of fertilizer increase yields.

Some areas are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, switchgrass, Kleingrass, and fescue are suitable improved pasture species. They are either grazed or harvested for hay. These grasses may be overseeded with legumes, such as bur, button, or white clovers and singletary peas, in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer will improve the quality and increase the quantity of the forage. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

A few areas are used as native pasture. The native vegetation consists of elm, pecan, ash, cottonwood, and hackberry with an understory of mid and tall grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for most urban uses because of the hazard of flooding.

The Belk soil is in capability subclass IIIs. The woodland ordination symbol is 7C.

BkA—Benklin silt loam, 0 to 1 percent slopes

This very deep, nearly level soil is on the first terrace level adjacent to the North Sulphur River flood plain. Areas are long and range in size from 30 to about 500 acres. The surface is plane to slightly convex.

Typical Profile

Surface layer:
0 to 8 inches, very dark grayish brown silt loam

Subsoil:
8 to 24 inches, very dark grayish brown silty clay loam
24 to 42 inches, very dark grayish brown silty clay loam with yellowish brown mottles
42 to 60 inches, dark grayish brown silty clay loam with dark yellowish brown mottles
60 to 76 inches, dark grayish brown clay loam with yellowish brown mottles

Substratum:
76 to 80 inches, grayish brown clay loam with yellowish brown mottles

Important Soil Properties

Available water capacity: high
Permeability: moderately slow
Drainage class: moderately well drained
Runoff: negligible
Water table: at a depth of 2.5 to 3.5 feet from November through May
Root zone: very deep
Soil reaction: slightly acid or neutral in the surface layer and in the upper part of the subsoil, slightly acid to moderately alkaline in the lower part of the subsoil
Shrink-swell potential: moderate
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Frioton, Hopco, and Tinn soils. Frioton and Tinn soils are in narrow, slightly concave areas near drainageways. Hopco soils are on alluvial fans of drainageways. A few areas of alkali soil, less than 2 acres in size, are adjacent to the more sloping uplands.

This soil is used mainly as cropland; the main crops are grain sorghum, soybeans, and corn. A few areas are used for wheat or alfalfa. Growing soil-improving crops and leaving crop residue on or near the soil surface improve soil tilth and productivity. Fertilizers will increase crop yields. Some areas need protection against runoff from adjacent hillsides. Timely and limited tillage minimizes soil compaction.

Some areas are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, introduced bluestems, lovegrass, indiangrass, and switchgrass are suitable improved pasture species. Pastures can be overseeded with arrowleaf, ball, hop, and white clovers as well as lespedeza, vetch, or singletary peas. These legumes will produce additional forage and add nitrogen to the soil. Applications of fertilizer will improve the quality and increase the quantity of the forage. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

A few small areas are used as native pasture. The native vegetation is a mixture of elm, hackberry, oak, osage orange, and pecan with an understory of bluestem and panicums. Eastern cottonwood, sweetgum, green ash, and pecan trees are adapted to this soil. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. Wetness and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations that must be considered when building sites are selected and the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. Wetness and moderately slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Benklin soil is in capability subclass IIw. The woodland ordination symbol is 5A.

BmC—Birome fine sandy loam, 2 to 5 percent slopes

This moderately deep, gently sloping soil is on upland ridges and low hills. The surface is convex. Areas are irregular in shape and range in size from 10 to 400 acres.

Typical Profile

Surface layer:
0 to 6 inches, brown fine sandy loam

Subsoil:
6 to 9 inches, reddish brown sandy clay
9 to 20 inches, red sandy clay
20 to 30 inches, red sandy clay with brown mottles

Substratum:
30 to 36 inches, red, weakly cemented sandstone interbedded with olive brown shaly material

Important Soil Properties

Available water capacity: low
Permeability: slow
Drainage class: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: moderately acid to neutral in the surface layer, strongly acid or moderately acid in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Crosstell soils and Rock outcrop. Crosstell soils are on lower side slopes. Outcrops of sandstone bedrock are on the more sloping portions of the unit.

Most areas are used as rangeland. The climax plant community is a post oak-blackjack oak savannah of tall and mid grasses. The woody overstory shades about 20 percent of the ground. The predominant grasses include little bluestem, indiangrass, switchgrass, purpletop, beaked panicum, Scribners panicum, Florida paspalum, and Canada wildrye. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Some areas are used as improved pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, introduced bluestems, lovegrass, switchgrass, and indiangrass are suitable improved pasture species. These grasses may be overseeded with legumes, such as arrowleaf, ball, hop, and white clovers as well as lespedeza, singletary peas, or vetch, in order to produce additional forage and add nitrogen to the soil. Yields are limited by the low available water capacity. Applications of fertilizer will improve the quality and increase the quantity of the forage. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

Cultivated crops are grown only in a few areas of this soil. High amounts of fertilizer and lime help to keep this soil at optimum production. Yields are limited by the low available water capacity. Growing soil-improving crops and keeping crop residue on the surface help to control erosion.

This soil has several limitations that affect urban uses. The moderate potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. Slow permeability and the depth to bedrock can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Birome soil is in capability subclass IIIe and in the Tight Sandy Loam range site.

BmD—Birome fine sandy loam, 5 to 12 percent slopes

This moderately deep, strongly sloping soil is on upland ridges and low hills. The surface is mostly convex. Areas are irregular in shape and range in size from 10 to 400 acres.

Typical Profile

Surface layer:
0 to 4 inches, dark brown fine sandy loam

Subsoil:
4 to 21 inches, reddish brown sandy clay

21 to 30 inches, red sandy clay with dark grayish brown mottles
30 to 36 inches, red sandy clay with light brownish gray and brownish yellow mottles

Substratum:
36 to 46 inches, mottled red and pale brown, weakly cemented sandstone interbedded with shaly material

Important Soil Properties

Available water capacity: low
Permeability: slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: moderately acid to neutral in the surface layer, strongly acid or moderately acid in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Crosstell soils and Rock outcrop. Crosstell soils are on the lower side slopes. Outcrops of sandstone bedrock are mostly in strongly sloping positions. Also included are some areas of Birome soils that have a stony surface layer, a few eroded areas with active V-shaped gullies, and small areas where the surface layer has been removed by erosion, leaving the subsoil exposed.

Most areas of this soil are used as rangeland. Production is limited by low natural fertility, the strongly acid reaction, and the low available water capacity. The climax plant community is a post oak-blackjack oak savannah of tall and mid grasses. The woody overstory shades about 20 percent of the ground. The predominant grasses include little bluestem, indiangrass, switchgrass, purpletop, beaked panicum, Scribner's panicum, Florida paspalum, and Canada wildrye. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is poorly suited to cultivation because of the slope and the severe hazard of water erosion.

Some areas of this soil are used as improved pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, introduced bluestems, lovegrass, switchgrass, and indiangrass are suitable improved pasture species. These grasses may be overseeded with legumes, such as arrowleaf, ball, hop, and white clovers as well as lespedeza, singletary peas, or vetch, in order to produce additional forage and add nitrogen to the soil. Establishing a stand of grass is difficult because of the severe hazard of water erosion, high runoff, and low available water capacity. Applications of fertilizer will improve the quality and increase the quantity of the forage. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

This soil has several limitations that affect urban uses. The slope and the moderate potential for shrinking and swelling of the subsoil with changes in moisture are limitations that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. The depth to bedrock and slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Birome soil is in capability subclass VIe and in the Tight Sandy Loam range site.

BoB—Bonham silt loam, 1 to 3 percent slopes

This very deep, very gently sloping soil is on uplands. Areas are irregular in shape and range in size from 20 to 1,350 acres. The surface is plane to slightly convex.

Typical Profile

Surface layer:
0 to 10 inches, very dark grayish brown silt loam

Subsoil:
10 to 17 inches, very dark grayish brown silty clay loam with brown mottles
17 to 30 inches, dark grayish brown silty clay with strong brown mottles
30 to 42 inches, mottled light olive brown and yellowish brown silty clay
42 to 56 inches, olive brown silty clay with yellowish brown and pale yellow mottles
56 to 65 inches, grayish brown silty clay with gray, dark yellowish brown, and strong brown mottles

Substratum:
65 to 80 inches, light olive gray silty clay with yellow mottles

Important Soil Properties

Available water capacity: high
Permeability: slow
Drainage class: moderately well drained

Runoff: medium
Water table: at a depth of 2.5 to 3.5 feet from October through May
Root zone: very deep
Soil reaction: moderately acid to slightly acid in the surface layer, slightly acid to moderately alkaline in the lower part of the subsoil
Shrink-swell potential: moderate in the surface layer and high in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Wilson, Normangee, and Crockett soils. Wilson soils are in slightly concave areas. Crockett soils are on low ridges. Normangee soils are in areas adjacent to drainageways. Also included are small areas of Bonham silt loam with slopes of less than 1 percent.

Most areas of this soil are used as cropland or improved pasture. Wheat and grain sorghum are the main crops. Terraces with grassed outlets and contour farming may be needed in some areas to help control erosion. Growing soil-improving crops and leaving crop residue on or near the soil surface improve soil tilth. Applications of fertilizer increase crop yields.

Some areas are used as improved pasture; coastal bermudagrass and common bermudagrass are the main improved pasture grasses grown on this soil. Other grasses that are suitable are fescue, lovegrass, switchgrass, bahiagrass, introduced bluestems, and indiangrass. Pastures may be overseeded with arrowleaf, ball, hop, and white clovers as well as lespedeza, vetch, or singletary peas. These legumes will produce additional forage and add nitrogen to the soil. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

A few areas are used as rangeland. The climax vegetation is mainly tall and mid grasses with widely scattered elm and hackberry trees. A few areas of native grasses, such as little bluestem, eastern gama, indiangrass, big bluestem, and switchgrass, are managed for hay production. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture and wetness are limitations that must be considered when the foundations of buildings are designed and building sites are selected. Low strength and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Wetness and slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Bonham soil is in capability subclass IIe and in the Clay Loam range site.

BoC—Bonham silt loam, 3 to 5 percent slopes

This very deep, gently sloping soil is on uplands. The surface is mostly convex. Areas mainly are long and narrow and range in size from 15 to 190 acres.

Typical Profile

Surface layer:
0 to 9 inches, very dark grayish brown silt loam

Subsoil:
9 to 15 inches, very dark grayish brown silty clay loam with red mottles
15 to 20 inches, very dark grayish brown silty clay with brown and reddish brown mottles
20 to 34 inches, grayish brown silty clay with yellowish red and brownish yellow mottles
34 to 44 inches, light grayish brown silty clay loam with yellowish brown and strong brown mottles
44 to 64 inches, light grayish brown silty clay loam with yellow and brown mottles and a few calcium carbonate concretions

Substratum:
64 to 80 inches, mottled brownish gray and olive gray silty clay loam with a few calcium carbonate concretions

Important Soil Properties

Available water capacity: high
Permeability: slow
Drainage class: moderately well drained
Runoff: medium
Water table: at a depth of 2.5 to 3.5 feet from October through May
Root zone: very deep
Soil reaction: moderately acid to slightly acid in the surface layer and in the upper part of the subsoil, slightly acid to moderately alkaline in the lower part of the subsoil
Shrink-swell potential: moderate in the surface layer and high in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Crockett and Normangee soils. Crockett soils have a brown loam surface layer over a mottled clay subsoil.

Normangee soils have a brown clay loam surface layer over a mottled clay subsoil.

Most areas of this soil are used as rangeland. The climax vegetation is a tall and mid grass prairie. Scattered elm and hackberry trees are in some areas. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Cultivated crops are grown in a few areas of this soil. Terraces with grassed outlets and contour farming will help to control water erosion. Growing soil-improving crops and leaving crop residue on or near the surface improve soil tilth. Applications of fertilizer increase crop yields.

A few areas are used as improved pasture; coastal bermudagrass and common bermudagrass are the main grasses grown. Other suitable grasses are fescue, lovegrass, switchgrass, bahiagrass, introduced bluestems, and indiangrass. These grasses may be overseeded with arrowleaf, ball, hop, and white clovers as well as lespedeza, vetch, or singletary peas in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

This soil has several limitations that affect urban uses. Wetness and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations that must be considered when the foundations of buildings are designed and building sites are selected. Low strength and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Wetness and slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Bonham soil is in capability subclass IIIe and in the Clay Loam range site.

BuA—Burleson clay, 0 to 1 percent slopes

This very deep, nearly level soil is on stream terraces. The surface is plane to slightly convex. Gilgai microrelief is in undisturbed areas. Areas are irregular in shape and range in size from 20 to about 500 acres.

Typical Profile

Surface layer:
0 to 20 inches, black clay

Subsoil:
20 to 42 inches, black clay with a few concretions and soft masses of calcium carbonate
42 to 60 inches, very dark gray clay with a few concretions and soft masses of calcium carbonate
60 to 72 inches, grayish brown clay with a few concretions of calcium carbonate

Substratum:
72 to 80 inches, light olive brown clay with a few concretions and soft masses of calcium carbonate

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly acid to slightly alkaline in the surface layer, slightly alkaline or moderately alkaline in the subsoil
Shrink-swell potential: very high
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Leson, Houston Black, and Wilson soils. Houston Black and Leson soils are on gently sloping uplands. Wilson soils have a loamy surface layer and are in slightly concave areas.

This soil is used mainly as cropland; corn, grain sorghum, wheat, and soybeans are the main crops (fig. 9). Maintaining good tilth is difficult. The soil surface becomes compacted if cultivated when wet and is cloddy if cultivated when too dry. Surface crusting and plowpans are common. The low runoff and very slow permeability cause extended periods of wetness in the surface layer that may delay planting and interfere with germination. Proper row direction will help to drain excess water. Growing soil-improving crops and leaving crop residue on or near the soil surface improve soil tilth. Applications of fertilizer increase crop yields.

Some areas of this soil are used as improved pasture. Coastal bermudagrass and common bermudagrass are the main improved pasture grasses. Other suitable grasses include bahiagrass, introduced bluestems, fescue, Kleingrass, weeping lovegrass, switchgrass, and indiangrass. These grasses may be overseeded with legumes, such as arrowleaf, ball, bur, button, hop, and white clovers as well as lespedeza, singletary peas, or vetch, in order to produce

Figure 9.—Soybeans in an area of Burleson clay, 0 to 1 percent slopes.

additional forage and add nitrogen to the soil. Weed control, applications of fertilizer, and proper grazing management will help to maintain optimum production.

Only a few areas of this soil are used as rangeland. The climax vegetation is a tall and mid grass prairie with scattered elm and hackberry trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Burleson soil is in capability subclass IIw and in the Blackland range site.

CrB—Crockett loam, 1 to 3 percent slopes

This very deep, very gently sloping soil is on broad upland ridges. Areas are irregular in shape and range in size from 15 to 1,100 acres.

Typical Profile

Surface layer:
0 to 8 inches, dark brown loam

Subsoil:
8 to 18 inches, mottled dark brown and dark reddish brown clay
18 to 34 inches, mottled olive gray, olive brown, and yellowish brown clay
34 to 46 inches, mottled olive and olive yellow clay
46 to 59 inches, mottled olive yellow and gray clay

Substratum:
59 to 80 inches, mottled gray and light olive brown clay loam

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: very deep, but the dense clay subsoil restricts root growth.
Soil reaction: moderately acid to neutral in the surface layer, slightly acid to moderately alkaline in the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Normangee and Wilson soils. Normangee soils have a clay loam surface layer. Wilson soils have a plane or slightly concave surface.

This soil is used mainly as improved pasture; coastal bermudagrass and common bermudagrass are the main grasses grown (fig. 10). Bahiagrass, weeping lovegrass, introduced bluestems, indiangrass, and switchgrass are suitable improved pasture species. Pastures can be overseeded with arrowleaf, ball, crimson, hop, and white clovers as well as lespedeza, vetch, or singletary peas for additional forage. These legumes will add nitrogen to the soil. Applications of fertilizer will increase yields. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

Cultivated crops are grown in a few areas of this soil. Wheat, grain sorghum, peanuts, and soybeans are the main cultivated crops. Droughtiness, poor subsoil tilth, and the hazard of erosion are the main limitations affecting crop growth. Terraces with grassed outlets and contour farming help to protect cultivated areas from water erosion. Growing cover crops and soil-improving crops and leaving crop residue on or near the soil surface help to control erosion and improve soil tilth. Applications of fertilizer increase yields.

Figure 10.—Round bales of coastal bermudagrass hay in an area of Crockett loam, 1 to 3 percent slopes.

Some areas of this soil are used as rangeland. Droughtiness is the main limitation affecting plant growth. The climax vegetation consists of bluestems, indiangrass, switchgrass, and gramas with scattered elm, hackberry, and a few mesquite trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Crockett soil is in capability subclass IIIe and in the Claypan Prairie range site.

CrC2—Crockett loam, 2 to 5 percent slopes, eroded

This very deep, gently sloping soil is on uplands. Areas are irregular in shape and range in size from 10 to 160 acres. All areas of this soil are gullied, but most gullies are partially healed. The gullies are about 100 to 300 feet apart, 1 to 3 feet deep, and 10 to 40 feet wide. They are mainly U-shaped. In most areas about 50 to 75 percent of the surface layer has been removed by sheet erosion. In some areas all of the surface layer has been eroded, leaving the clayey subsoil exposed.

Typical Profile

Surface layer:
0 to 3 inches, brown loam

Subsoil:
3 to 15 inches, mottled brown, dark reddish brown, and dark red clay
15 to 35 inches, mottled dark reddish brown, dark grayish brown, and olive brown clay
35 to 50 inches, mottled olive brown, light olive brown, and gray clay
50 to 60 inches, mottled olive brown and gray clay loam

Substratum:
60 to 80 inches, light olive brown loam

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep; but the dense clay subsoil restricts root growth.
Soil reaction: slightly acid or neutral in the surface layer and in the upper part of the subsoil, slightly alkaline to moderately alkaline in the lower part of the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Normangee soils. These soils have a clay loam surface layer.

Most areas of this soil were formerly cultivated but are now used as rangeland. Poor-quality grasses that provide very low amounts of forage are predominant. The major limitations are low natural fertility, the hazard of erosion, and droughtiness. The climax vegetation includes grasses, such as little bluestem, indiangrass, switchgrass, and gramas. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is poorly suited to cropland because of low natural fertility, droughtiness, and the severe hazard of water erosion.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Crockett soil is in capability subclass IVe and in the Claypan Prairie range site.

CtC—Crosstell fine sandy loam, 2 to 5 percent slopes

This very deep, gently sloping soil is on upland ridges and side slopes. Areas are irregular in shape and range in size from 10 to 1,500 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 6 inches, very dark grayish brown fine sandy loam

Subsoil:
6 to 24 inches, yellowish red clay
24 to 44 inches, dark brown clay

Substratum:
44 to 60 inches, yellowish red clay

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid to neutral in the surface layer, strongly acid to neutral in the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Bastrop and Birome soils. Bastrop soils have a sandy clay loam subsoil. Birome soils are 20 to 40 inches deep.

Most areas of this soil are rangeland or abandoned cropland. The native vegetation consists of a post oak-blackjack oak savannah with tall and mid grasses, such as little bluestem, sideoats grama, and purpletop. Threeawn is the primary grass in idle and abandoned cultivated fields. The main limitations affecting plant growth are low natural fertility and the severe hazard of water erosion. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas of this soil are used as improved pasture; coastal bermudagrass and common bermudagrass are the main grasses grown. Bahiagrass, introduced bluestems, indiangrass, switchgrass, and weeping lovegrass are suitable improved pasture species. Areas can be overseeded with arrowleaf, ball, crimson, and white clovers as well as lespedeza, vetch, or singletary peas. These legumes will produce additional forage and add nitrogen to the soil. Applications of fertilizer increase yields. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

This soil is poorly suited to cultivated crops. When the soil is cultivated, wheat and grain sorghum are the main crops. Low natural fertility and the severe hazard of water erosion are the main limitations affecting crop growth. Terraces and contour farming help to control erosion. Growing cover crops and soil-improving crops and leaving crop residue on or near the soil surface help to control erosion and improve soil tilth. Applications of fertilizer increase yields.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Crosstell soil is in capability subclass IVe and in the Tight Sandy Loam range site.

CtD2—Crosstell fine sandy loam, 5 to 12 percent slopes, eroded

This very deep, strongly sloping soil is on upland side slopes. It has gullies about 100 to 300 feet apart, 1 to 5 feet deep, and 5 to 20 feet wide. Most of the gullies are V-shaped. Areas generally are long, follow the contour, and range in size from 10 to 450 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 5 inches, very dark grayish brown fine sandy loam

Subsoil:
5 to 24 inches, yellowish red clay
24 to 44 inches, dark brown clay

Substratum:
44 to 60 inches, yellowish red clay

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid to neutral in the surface layer, strongly acid to neutral in the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Bastrop and Birome soils. Bastrop soils are in gently sloping areas and have a sandy clay loam subsoil. Birome soils are 20 to 40 inches deep.

Most areas of this soil are rangeland or abandoned cropland. The native vegetation consists of a post oak-blackjack oak savannah of tall and mid grasses, such as little bluestem, side oats grama, and purpletop. Threeawn is the primary grass on abandoned cropland. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas are used as improved pasture; coastal bermudagrass and common bermudagrass are the main grasses grown. Other improved pasture grasses include bahiagrass, introduced bluestems, indiangrass, switchgrass, and weeping lovegrass. Pastures may be overseeded with arrowleaf, ball, and crimson clovers as well as lespedeza, vetch, or singletary peas in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer will improve the quality and increase the quantity of the forage. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

This soil is poorly suited to cropland because of the hazard of water erosion.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Crosstell soil is in capability subclass VIe and in the Tight Sandy Loam range site.

DaC—Dalco clay, 3 to 5 percent slopes

This moderately deep, gently sloping soil is on upland ridges and side slopes. Areas mainly are oblong and range in size from 20 to 300 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 12 inches, very dark gray clay
12 to 26 inches, very dark gray clay

Subsoil:
26 to 36 inches, dark gray clay

Substratum:
36 to 46 inches, light gray, pale brown, and yellow chalk

Important Soil Properties

Available water capacity: low
Permeability: very slow
Drainage class: moderately well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Austin, Fairlie, and Stephen soils. Austin soils have a brown silty clay loam surface layer. Fairlie soils are 40 to 60 inches deep. Stephen soils are less than 20 inches deep.

This soil is used mainly as cropland; wheat and grain sorghum are the main crops. The hazard of water erosion is a limitation. Terraces and contour farming help to control water erosion. Growing cover crops and soil-improving crops and leaving crop residue on or near the soil surface help to control erosion and improve soil tilth. Applications of fertilizer increase crop yields.

Some areas of this soil are used as improved pasture; coastal bermudagrass and common bermudagrass are the main grasses grown. Kleingrass, lovegrass, introduced bluestems, switchgrass, and indiangrass are also suitable improved pasture species. Pastures may be overseeded with arrowleaf, bur, button, red, and white clovers as well as vetch or singletary peas in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

Only a few areas of this soil are used as rangeland. The climax vegetation consists of grasses, such as little bluestem, big bluestem, indiangrass, switchgrass, and sideoats grama. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. The depth to bedrock and very slow permeability can interfere with the proper functioning of septic tank absorption fields.

Corrosivity is a limitation affecting the use of unprotected steel.

The Dalco soil is in capability subclass IIIe and in the Blackland range site.

De—Dela loam, occasionally flooded

This very deep, nearly level soil is on flood plains along creeks and the larger drainageways. Slopes are 0 to 1 percent. Areas are flooded about one time in 5 to 10 years. They are dissected by meandering channels 3 to 6 feet deep and 10 to 20 feet wide.

Typical Profile

Surface layer:
0 to 12 inches, brown loam

Underlying material:
12 to 30 inches, brown loam
30 to 80 inches, reddish yellow loam

Important Soil Properties

Available water capacity: moderate
Permeability: moderately rapid
Drainage class: moderately well drained
Runoff: negligible
Water table: at a depth of 3 to 5 feet from November through May
Root zone: very deep
Soil reaction: moderately acid to neutral
Shrink-swell potential: low
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Hopco soils. These soils are in areas that have a slightly concave surface.

This soil is used mainly as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, Kleingrass, and switchgrass are suitable improved pasture species. These grasses may be overseeded with legumes, such as arrowleaf, ball, bur, button, hop, red, and white clovers as well as singletary peas and vetch, in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer will improve the quality and increase the quantity of the forage. Proper grazing management and weed control are needed.

This soil is suited to cultivated crops. Improving soil tilth and maintaining productivity are management concerns.

A few areas of this soil are used as native pasture. The climax vegetation consists of red oaks, hickory, pecan, elm, ash, and sycamore with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Dela soil is in capability subclass IIw. The woodland ordination symbol is 4A.

Df—Dela loam, frequently flooded

This very deep, nearly level soil is on flood plains along creeks and drainageways. Slopes are 0 to 1 percent. Areas are dissected by meandering channels 3 to 6 feet deep and 15 to 25 feet wide. This soil is flooded one or more times each year.

Typical Profile

Surface layer:
0 to 10 inches, dark brown loam

Underlying material:
10 to 47 inches, brown loam
47 to 70 inches, brown loam with light brownish gray and reddish brown mottles

Important Soil Properties

Available water capacity: moderate
Permeability: moderately rapid
Drainage class: moderately well drained
Runoff: negligible
Water table: at a depth of 3 to 5 feet from November through May
Root zone: very deep
Soil reaction: moderately acid to neutral
Shrink-swell potential: low
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Hopco soils. These soils are in areas that have a slightly concave surface.

Most areas of this soil are used as native pasture. The climax vegetation consists of red oak, hickory, pecan, elm, and sycamore trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is poorly suited to cropland because of the hazard of flooding.

A few areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, switchgrass, and Kleingrass are suitable improved pasture species. Legumes, such as arrowleaf, ball, button, hop, red, and white clovers as well as lespedeza, singletary peas, and vetch, can be grown with these grasses in

order to produce additional forage and add nitrogen to the soil. Proper grazing management, weed control, and fertilization are needed.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Dela soil is in capability subclass Vw. The woodland ordination symbol is 4A.

DgA—Derly silt loam, 0 to 1 percent slopes

This very deep, nearly level soil is on the second terrace level of the Red River. The surface is slightly concave. Areas generally are oblong and range in size from 20 to 700 acres. Slopes generally are less than 0.5 percent.

Typical Profile

Surface layer:
0 to 3 inches, very dark gray silt loam

Subsurface layer:
3 to 5 inches, light gray silt loam

Subsoil:
5 to 11 inches, very dark gray clay with vertical streaks of gray loam
11 to 25 inches, very dark gray clay
25 to 42 inches, dark gray clay loam
42 to 80 inches, gray clay loam with yellowish red mottles

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: poorly drained
Runoff: negligible
Water table: perched at the surface to a depth of 1 foot from November through May
Root zone: very deep, but the dense clay subsoil restricts root growth.
Soil reaction: strongly acid or moderately acid in the surface layer and in the upper part of the subsoil, moderately acid to neutral in the lower part of the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are areas of Karma, Raino, Freestone, and Porum soils. Raino soils are in mounded areas. Freestone soils are in the higher, gently sloping areas. The upper part of their subsoil is loamy, and the lower part is clayey. Porum soils are gently sloping, are near drainageways, and have a clay subsoil. Karma soils are on narrow ridges and have a sandy clay loam subsoil.

This soil is used mainly as native pasture. The climax vegetation consists of elm, post oak, willow oak, and water oak. Grasses include panicums, longleaf uniola, and sedges. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Some areas are used as improved pasture. Common grasses are fescue and switchgrass. White clover can be overseeded. Wetness is the most limiting factor. Water-tolerant grasses and legumes should be selected. Grazing should be limited during wet periods. Fertilization, liming, and surface drainage increase yields.

Only a few areas of this soil are used for crops. Wheat is the major crop. Wetness can delay planting and harvesting in spring and late fall. In addition, this soil is droughty during the summer. The droughtiness limits the production of warm-season crops. Proper fertilizer applications increase yields.

This soil has several limitations that affect urban uses. Wetness and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations that must be considered when building sites are selected and the foundations of buildings are designed. The potential for shrinking and swelling of the subsoil with changes in moisture, low strength, and wetness are limitations when streets and roads are constructed. Wetness and very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Derly soil is in capability subclass IVw. The woodland ordination symbol is 4W.

DrA—Derly-Raino complex, 0 to 1 percent slopes

These very deep, nearly level to slightly concave soils are on the second terrace level of the Red River. In this unit there are many scattered pimple mounds, except in cultivated areas where mounds have been smoothed. Areas range from 20 to 1,500 acres in size. Slopes are 0 to 1 percent.

This unit is about 55 percent Derly soil, 30 percent Raino soil, and 15 percent other soils. The Raino soil is on oval pimple mounds that are about 35 feet wide and 80 feet long. Mounded areas are irregularly spaced. The Derly soil is in the intermound areas. The

soils of this complex are too intricately mixed to be mapped separately at the scale used.

Typical Profile of the Derly Soil

Surface layer:
0 to 6 inches, very dark grayish brown silt loam

Subsoil:
6 to 14 inches, dark gray clay with vertical streaks of gray silt loam
14 to 30 inches, dark gray clay
30 to 44 inches, dark gray clay loam with olive yellow mottles
44 to 56 inches, gray clay loam with yellowish red mottles
56 to 80 inches, mottled light brownish gray and light olive brown clay loam

Important Properties of the Derly Soil

Available water capacity: high
Permeability: very slow
Drainage class: poorly drained
Runoff: negligible
Water table: perched at the surface to a depth of 1 foot from November through May
Root zone: very deep, but the dense clay subsoil restricts root growth.
Soil reaction: strongly acid or moderately acid in the surface layer and in the upper part of the subsoil, moderately acid to neutral in the lower part of the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Typical Profile of the Raino Soil

Surface layer:
0 to 8 inches, dark grayish brown very fine sandy loam

Subsoil:
8 to 26 inches, brown loam
26 to 36 inches, light yellowish brown loam with gray, yellowish red, and red mottles and with streaks and pockets of pale brown sand
36 to 43 inches, yellowish brown clay loam with yellowish brown and red mottles and with streaks and pockets of light gray sand
43 to 68 inches, gray clay loam with yellowish brown and red mottles
68 to 80 inches, mottled dark gray and yellowish brown clay loam

Important Properties of the Raino Soil

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: low
Water table: perched at a depth of 2.0 to 3.5 feet from December through May
Root zone: very deep
Soil reaction: strongly acid to slightly acid in the surface layer, very strongly acid to moderately acid in the subsoil
Shrink-swell potential: low in the surface layer and in the upper part of the subsoil and high in the lower part of the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included in this complex in mapping are small areas of Freestone, Waskom, and Porum soils. Freestone soils are in the slightly higher, gently sloping areas. The upper part of their subsoil is loamy, and the lower part is clayey. Waskom soils are in the slightly higher areas. Porum soils are on gently sloping side slopes adjacent to natural drainageways.

Most areas of this complex are used as native pasture. The native vegetation consists of elm, post oak, willow oak, and water oak. Grasses include panicum, longleaf uniola, broomsedge bluestem, and sedges. Wetness is the most limiting factor affecting timber production. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Some areas are used as improved pasture. Fescue, bahiagrass, switchgrass, and bermudagrass are the main improved pasture grasses. Bermudagrass and bahiagrass grow well on the Raino soil, but wetness can limit their growth on the Derly soil. White, ball, and hop clovers, lespedeza, and singletary peas can be overseeded into grasses in order to produce additional forage and to provide additional nitrogen for grass production. Applications of fertilizer and lime increase yields. Proper grazing management maintains plant vigor, the ground cover, and soil tilth.

Some areas of this complex are used as cropland. These soils are difficult to work. Wetness may delay harvesting and planting in fall and spring. When the Raino soil is ready for cultivation, the Derly soil is still too wet. Wheat is the major crop grown on these soils. Applications of fertilizer can increase yields.

This soil has several limitations that affect urban uses. Wetness and the potential for shrinking and swelling of the subsoil with changes in moisture are

limitations that must be considered when building sites are selected and the foundations of buildings are designed. Low strength, wetness, and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Wetness and very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

In areas of the Derly soil, the capability subclass is IVw and the woodland ordination symbol is 4W. In areas of the Raino soil, the capability subclass IIIs and the woodland ordination symbol is 9W.

Eb—Elbon silty clay loam, frequently flooded

This very deep, nearly level soil is on narrow flood plains along local streams. Areas have meandering channels that are 5 to 10 feet deep and 10 to 20 feet wide. This soil is flooded several times a year. Areas are about 150 to 300 feet wide. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 22 inches, very dark grayish brown silty clay loam

Underlying material:
22 to 80 inches, dark brown silty clay loam

Important Soil Properties

Available water capacity: high
Permeability: moderately slow
Drainage class: moderately well drained
Runoff: negligible
Water table: at a depth of 2.5 to 3.5 feet from December through April
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Hopco and Frioton soils. Hopco soils have colors similar to those of the Elbon soil and are noncalcareous. The surface layer of Frioton soils is thicker than that of the Elbon soil.

This soil is used mainly as native pasture. The native vegetation consists of oak, elm, hackberry, pecan, and ash with an understory of tall grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Because of the hazard of flooding, this soil is poorly suited to cropland and is unsuitable for urban uses.

The Elbon soil is in capability subclass Vw. The woodland ordination symbol is 3W.

EsD2—Ellis clay, 5 to 12 percent slopes, eroded

This very deep, strongly sloping soil is on upland side slopes. The surface is convex. Areas have a few V-shaped gullies and many active rills, and 50 percent or more of the surface layer has been removed.

Typical Profile

Surface layer:
0 to 4 inches, dark grayish brown clay

Subsoil:
4 to 18 inches, dark olive gray clay
18 to 30 inches, mottled olive and olive brown clay

Substratum:
30 to 66 inches, light brownish gray clay with olive yellow streaks

Important Soil Properties

Available water capacity: moderate
Permeability: very slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: neutral to moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Normangee and Ferris soils. Normangee soils are in gently sloping areas and have a clay loam surface layer. Ferris soils have colors similar to those of the Ellis soil and are calcareous throughout. Also included are small areas of Ellis soils that have a thicker surface layer.

This soil is used mainly as rangeland. Some areas were once cultivated, eroded, and allowed to return to grass. The native vegetation consists of little bluestem, indiangrass, sideoats grama, and Texas wintergrass with scattered elm, hackberry, and eastern redredar. Most of the areas that were once cultivated support low-quality grasses. Proper management of grazing

heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas are used as improved pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, introduced bluestems, lovegrass, switchgrass, and indiangrass are suitable improved pasture species. These grasses may be overseeded with legumes, such as arrowleaf, ball, bur, button, and hop clovers as well as singletary peas or vetch, in order to produce additional forage and add nitrogen to the soil. The severe hazard of water erosion makes it difficult to establish stands of grass. Proper grazing management is needed to help maintain plant vigor, the ground cover, and soil tilth.

This soil is poorly suited to cultivated crops because of the severe hazard of water erosion.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. The slope is a limitation when building sites are selected. The potential for shrinking and swelling with changes in moisture and low strength are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Ellis soil is in capability subclass VIe and in the Eroded Blackland range site.

FaA—Fairlie clay, 0 to 1 percent slopes

This deep, nearly level soil is on uplands. Areas range from 50 to 1,000 acres in size. Slopes are less than 0.5 percent.

Typical Profile

Surface layer:
0 to 30 inches, black clay

Subsoil:
30 to 40 inches, very dark gray clay
40 to 50 inches, dark grayish brown clay

Substratum:
50 to 60 inches, white, platy chalk

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: deep
Soil reaction: moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Houston Black and Burleson soils. Houston Black soils are gently sloping and are underlain by clays and marls. Burleson soils are underlain by clay sediments.

This soil is used mostly as cropland. The main crops are wheat, grain sorghum (fig. 11), and corn. Cotton is grown in a few areas. This soil becomes compacted if tilled when wet. Growing cover crops and soil-improving crops and incorporating plant residue into the surface layer will improve soil tilth. Applications of fertilizer increase yields. Wetness can delay spring planting.

Some areas of this soil are used as improved pasture. The most commonly grown improved pasture grasses are coastal bermudagrass and common bermudagrass. Indiangrass, introduced bluestems, fescue, Kleingrass, lovegrass, and switchgrass also are suitable improved pasture species. These grasses may be overseeded with legumes, such as white, arrowleaf, bur, button, and red clovers as well as vetch or singletary peas, in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer and controlled grazing increase yields. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Only a few areas of this soil are used as rangeland. The climax vegetation is a tall and mid grass prairie. The main grasses include little bluestem, eastern gamagrass, indiangrass, and switchgrass. Proper grazing management and weed control help to maintain or increase forage production.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Fairlie soil is in capability subclass IIs and in the Blackland range site.

Figure 11.—Grain sorghum in an area of Fairlie clay, 0 to 1 percent slopes.

FdB—Fairlie-Dalco complex, 1 to 3 percent slopes

These deep and moderately deep soils are on uplands. Areas range from about 20 to 1,600 acres in size.

This unit is about 60 percent Fairlie soil, 30 percent Dalco soil, and 10 percent other soils. The Fairlie soil is 40 to 60 inches deep over chalk. The Dalco soil is 24 to 40 inches deep over chalk. These soils cannot be mapped separately at the scale used.

Typical Profile of the Fairlie Soil

Surface layer:
0 to 42 inches, black clay

Subsoil:
42 to 54 inches, very dark grayish brown clay

Substratum:
54 to 60 inches, white chalk

Important Properties of the Fairlie Soil

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: deep
Soil reaction: moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Typical Profile of the Dalco Soil

Surface layer:
0 to 28 inches, black clay

Subsoil:
28 to 36 inches, very dark grayish brown clay

Substratum:
36 to 46 inches, white, platy chalk

Important Properties of the Dalco Soil

Available water capacity: low
Permeability: very slow
Drainage class: moderately well drained
Runoff: high
Water table: none within a depth of 6 feet

Root zone: moderately deep
Soil reaction: moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with these soils in mapping are small areas of Austin, Howe, Stephen, and Whitewright soils. Austin soils are on gently sloping ridges. They have a dark grayish brown surface layer. Stephen soils are shallow to bedrock. Howe and Whitewright soils are adjacent to drainageways. They have a grayish brown surface layer.

Most areas of this complex are used as cropland. The main crops are wheat, grain sorghum, and corn. Cotton and soybeans are grown in a few areas. These soils will become compacted if cultivated when wet. Growing cover crops and soil-improving crops and incorporating plant residue into the surface layer improve soil tilth. Terraces with stable grass outlets and contour farming will help to control water erosion. Applications of fertilizer increase yields.

Some areas of this complex are used as improved pasture. The most common improved pasture grasses are coastal bermudagrass and common bermudagrass. Introduced bluestems, fescue, Kleingrass, lovegrass, indiangrass, and switchgrass also are suitable improved pasture species. These grasses may be overseeded with legumes, such as arrowleaf, bur, button, red, and white clovers as well as vetch or singletary peas, in order to produce additional forage and add nitrogen to the soils. Applications of fertilizer and controlled grazing increase yields.

A few areas of this complex are used as rangeland. The native vegetation is a tall and mid grass prairie which includes little bluestem, switchgrass, eastern gamagrass, and indiangrass. Controlled grazing helps to maintain or increase forage production. Native grasses are used for hay production in some areas of this complex.

These soils have several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability in both the Farlie and Dalco soils and the depth to bedrock in the Dalco soil can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Fairlie and Dalco soils are in capability subclass IIe and in the Blackland range site.

FeD2—Ferris clay, 5 to 12 percent slopes, eroded

This very deep, strongly sloping soil is on side slopes adjacent to drainageways. Areas are long, irregularly shaped bands that follow the contour of the landscape. Most of these areas were once cultivated. Erosion has removed 6 to 8 inches of the surface layer from the upper slopes. Natural drainageways and V-shaped gullies 200 to 400 feet apart are common; these are 4 to 6 feet deep and 30 feet wide. Some gullied areas have been smoothed. The surface is convex. Areas range from 15 to 800 acres in size.

Typical Profile

Surface layer:
0 to 6 inches, dark olive gray clay

Subsoil:
6 to 45 inches, olive clay

Substratum:
45 to 80 inches, stratified olive and yellow shale with clay texture

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: very high
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Heiden and Lamar soils. Heiden soils are on gently sloping foot slopes. Lamar soils are in convex areas above broad flood plains. In a few areas where this soil is closely associated with shallow soils underlain by chalk, narrow chalk ledges crop out. Severely eroded soils are included in some mapped areas 1 to 4 acres in size. These areas have gullies, 2 to 6 feet deep and 2 to 25 feet wide, that funnel into a single deep gully, or they have gullies that run the length of the slope and are 50 to 120 feet apart. Also included are areas of Ferris soils that have a thicker surface layer.

This soil is used mainly as rangeland (fig. 12). The native vegetation is a tall and mid grass prairie with scattered trees. Management concerns are proper stocking rates, controlled grazing, and brush management.

Some areas of this soil are used as improved pasture. Improved pasture grasses include coastal

Figure 12.—Native grass in an area of Ferris clay, 5 to 12 percent slopes, eroded.

bermudagrass, common bermudagrass, introduced bluestems, fescue, Kleingrass, lovegrass, switchgrass, and indiangrass. These grasses may be overseeded with legumes, such as arrowleaf, bur, button, red, and white clovers as well as vetch and singletary peas, in order to produce additional forage and add nitrogen to the soil. Establishing improved pasture plants is difficult because of the severe hazard of erosion. After the plants are established, proper grazing management is needed to maintain plant vigor and the ground cover.

This soil is poorly suited to cropland because of the severe hazard of water erosion.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Ferris soil is in capability subclass VIe and in the Eroded Blackland range site.

FhB—Freestone-Hicota complex, 0 to 2 percent slopes

These very deep soils are in broad areas, mostly on the third terrace level of the Red River. The surface is slightly convex. Areas have pimple mounds. In uncultivated areas these mounds are 35 to 85 feet across, 2 to 4 feet high, and 50 to 200 feet apart. In areas of cropland the pimple mounds have been smoothed by extensive cultivation. Areas range from 20 to about 1,000 acres in size.

This unit is about 63 percent Freestone soil, 24 percent Hicota soil, and 13 percent other soils. The Freestone soil is in low areas between the mounds. The Hicota soil is on the pimple mounds, which occur in a random pattern. The soils of this unit are too intricately mixed to be separated at the scale of mapping used.

Typical Profile of the Freestone Soil

Surface layer:
0 to 5 inches, dark yellowish brown loam

Subsurface layer:
5 to 10 inches, light yellowish brown loam

Subsoil:
10 to 18 inches, strong brown loam with yellowish brown mottles
18 to 24 inches, strong brown sandy clay loam with red and gray mottles
24 to 30 inches, light gray clay loam with dark red and yellowish brown mottles and vertical streaks of light brownish gray fine sandy loam
30 to 44 inches, mottled light gray and dark red clay loam
44 to 58 inches, dark red clay loam with light gray mottles
58 to 80 inches, red clay loam with brown mottles

Important Properties of the Freestone Soil

Available water capacity: high
Permeability: slow
Drainage class: moderately well drained
Runoff: low
Water table: perched at a depth of 2.0 to 3.5 feet from December through May
Root zone: very deep
Soil reaction: strongly acid to neutral in the surface layer, very strongly acid to slightly acid in the subsoil
Shrink-swell potential: low in the surface layer, moderate in the upper part of the subsoil, and high in the lower part of the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Typical Profile of the Hicota Soil

Surface layer:
0 to 4 inches, brown loam

Subsurface layer:
4 to 14 inches, light yellowish brown loam

Subsoil:
14 to 26 inches, strong brown and yellowish red loam
26 to 32 inches, dark brown clay loam with vertical streaks of white sand and silt
32 to 44 inches, dark brown clay loam with light reddish brown and red mottles and vertical streaks of white sand and silt
44 to 54 inches, mottled red and dark gray clay loam
54 to 80 inches, mottled red, strong brown, and brown clay loam

Important Properties of the Hicota Soil

Available water capacity: very high
Permeability: slow
Drainage class: moderately well drained
Runoff: low
Water table: at a depth of 3 to 5 feet from November through May
Root zone: very deep
Soil reaction: strongly acid to slightly acid in the surface layer, very strongly acid to moderately acid in the subsoil
Shrink-swell potential: low in the surface layer, moderate in the upper part of the subsoil, and high in the lower part of the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with these soils in mapping are small areas of Whakana, Raino, and Ivanhoe soils. Whakana soils are on gently sloping side slopes adjacent to drainageways. Raino soils are on pimple mounds 1 to 3 feet high. Ivanhoe soils are in nearly level areas.

This complex is used mainly as improved pasture. Improved pasture grasses include coastal bermudagrass, common bermudagrass, bahiagrass, introduced bluestems, lovegrass, switchgrass, indiangrass, and fescue. These grasses may be overseeded with legumes, such as arrowleaf, ball, hop, and white clovers as well as lespedeza, singletary peas, and vetch, in order to produce additional forage and add nitrogen to the soils. Applications of fertilizer will improve the quality and increase the quantity of the forage. Additions of lime may be needed to correct soil acidity. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Some areas of this complex are used as cropland. The main crops are corn, grain sorghum, peanuts, and soybeans. Crop rotation helps to control weeds, insects, and disease. Growing soil-improving crops and incorporating plant residue into the surface layer or maintaining plant residue on the soil surface improve soil tilth. Applications of fertilizer will increase yields. Additions of lime may be needed to correct soil acidity.

A few areas of this complex are used as native pasture. The climax vegetation consists of post oak, blackjack oak, hickory, sweetgum, red oak, and elm. Understory grasses include little bluestem, beaked panicum, longleaf uniola, purple top, and low panicums. Loblolly pine has been planted in a few areas. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Several areas are used for orchards or truck crops. Peaches, pears, and apples are the main orchard crops. Watermelons, black-eyed peas, sweet corn, sweet potatoes, and strawberries are the main truck crops.

These soils have several limitations that affect urban uses. Wetness in both the Freestone and Hicota soils and the potential for shrinking and swelling in the subsoil of the Freestone soil with changes in moisture are limitations that must be considered when the foundations of buildings are designed. Low strength of the Freestone soil is a limitation when streets and roads are constructed. Slow permeability and wetness can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

In areas of the Freestone soil, the capability subclass IIe and the woodland ordination symbol is 8W. In areas of the Hicota soil, the capability subclass IIs and the woodland ordination symbol is 6A.

Fr—Frioton silty clay loam, occasionally flooded

This very deep, nearly level soil is on flood plains along streams. It is protected from frequent flooding by levees or by deeply channeled drainageways. Slopes are plane and range from 0 to slightly over 1 percent.

Typical Profile

Surface layer:
0 to 8 inches, very dark brown silty clay loam
8 to 24 inches, very dark grayish brown silty clay loam

Subsoil:
24 to 60 inches, black silty clay

Substratum:
60 to 70 inches, very dark gray silty clay
70 to 80 inches, dark grayish brown silty clay loam

Important Soil Properties

Available water capacity: high
Permeability: moderately slow
Drainage class: well drained
Runoff: low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Tinn soils. These soils are in areas near Bois d'Arc Creek.

This soil is used mainly as cropland; wheat, grain sorghum, and corn are the main crops. Growing soil-improving crops and leaving plant residue on or near the soil surface improve soil tilth.

Some areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, Kleingrass, and switchgrass are suitable grasses. These grasses may be overseeded with legumes, such as bur, button, and white clovers as well as singletary peas, in order to produce additional forage and add nitrogen to the soil. Alfalfa also is grown on this soil. Applications of fertilizer increase the quantity and improve the quality of the forage. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Only a few areas of this soil are used as native pasture. The native vegetation consists of oak, elm, hackberry, pecan, and ash with an understory of native grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Frioton soil is in capability subclass IIw and the Loamy Bottomland range site. The woodland ordination symbol is 4C.

HeB—Heiden clay, 1 to 3 percent slopes

This very deep, very gently sloping soil is on shoulder slopes and upper side slopes of low ridges. Gilgai microrelief is in the few remaining undisturbed areas. Areas are oblong, follow the contour of the slope, and range in size from 30 to 1,400 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 10 inches, very dark grayish brown clay

Subsoil:
10 to 40 inches, very dark grayish brown clay
40 to 65 inches, olive brown clay

Substratum:
65 to 80 inches, mottled olive yellow, light olive brown, and light olive gray clay

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: very high
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Ferris, Houston Black, and Leson soils. Ferris soils are in strongly sloping areas. Houston Black and Leson soils are on foot slopes and along natural drainageways. Also included are areas of Heiden soils that have had the surface layer removed by sheet erosion, are rilled, or have one or more V-shaped gullies 3 to 5 feet deep.

This soil is used mainly as improved pasture. Coastal bermudagrass and common bermudagrass are the main grasses. Switchgrass, introduced bluestems, fescue, Kleingrass, lovegrass, and indiangrass also are suitable improved pasture species. These grasses may be overseeded with legumes, such as arrowleaf, bur, button, red, and white clovers as well as vetch and singletary peas, in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer will improve the quality and increase the quantity of the forage. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Some areas of this soil are cultivated. Wheat and grain sorghum are the main crops. Growing cover crops and soil-improving crops and leaving crop residue on or near the soil surface help to control erosion and improve soil tilth. Terraces with stable outlets help to control water erosion. Applications of fertilizer increase yields.

A few areas are used as rangeland. The climax vegetation is a tall and mid grass prairie with scattered elm and hackberry trees and an occasional mesquite tree. Proper stocking rates, controlled grazing, and brush control are management concerns in these areas.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Heiden soil is in capability subclass IIe and in the Blackland range site.

HfC2—Heiden-Ferris complex, 2 to 6 percent slopes, eroded

These very deep soils are on the gently sloping, convex upper side slopes of low ridges. Gullies 1 to 5 feet deep, 8 to 65 feet wide, and 60 to 300 feet apart run the length of the slope. Areas are long and narrow. They range in size from 15 to 200 acres.

This complex is about 50 percent Heiden soil, 35 percent Ferris soil, and 15 percent other soils. The Heiden soil is on slightly concave slopes. The Ferris soil is on the steeper, upper convex slopes and the bottoms of wide, parabolic-shaped, shallow gullies that are common in many areas. The soils occur in patterns too intricate to be delineated separately at the scale of mapping used.

Typical Profile of the Heiden Soil

Surface layer:
0 to 8 inches, black clay
8 to 20 inches, very dark grayish brown clay

Subsoil:
20 to 36 inches, dark grayish brown clay
36 to 58 inches, yellowish brown clay

Substratum:
58 to 80 inches, mottled yellowish brown and light brownish gray clay

Important Properties of the Heiden Soil

Available water capacity: high
Permeability: very slow
Drainage class: well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: very high
Hazard of water erosion: severe
Hazard of wind erosion: slight

Typical Profile of the Ferris Soil

Surface layer:
0 to 5 inches, very dark grayish brown clay

Subsoil:
5 to 24 inches, dark grayish brown clay
24 to 42 inches, pale olive clay

Substratum:
42 to 80 inches, stratified light yellowish brown and light brownish gray shale with clay texture

Important Properties of the Ferris Soil

Available water capacity: high
Permeability: very slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline

Shrink-swell potential: very high
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with these soils in mapping are small areas of Houston Black and Leson soils. Houston Black soils are in gently sloping areas on narrow ridgetops and in areas adjacent to drainageways. Leson soils are in gently sloping areas adjacent to drainageways.

This complex is used mainly as rangeland. The climax vegetation consists of a tall and mid grass prairie with scattered elm, hackberry, bois d’arc, and mesquite trees. Proper stocking rates, controlled grazing, and brush control are management concerns in these areas.

Some areas are used as improved pasture. Coastal bermudagrass and common bermudagrass are the main grasses. Switchgrass, indiangrass, introduced bluestems, Kleingrass, lovegrass, and fescue also are suitable improved pasture species. These grasses may be overseeded with legumes, such as arrowleaf, bur, button, red, and white clovers as well as vetch and singletary peas, in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Only a few areas of this complex are used as cropland. The slope, the high or very high runoff, and the severe hazard of erosion are limitations in cultivated areas. Growing cover crops and soil-improving crops and leaving crop residue on or near the soil surface help to control erosion and improve soil tilth. Terraces with stable outlets help to control water erosion.

These soils have several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Heiden and Ferris soils are in capability subclass IIIe. The Heiden soil is in the Blackland range site, and the Ferris soil is in the Eroded Blackland range site.

Hm—Hopco silt loam, occasionally flooded

This very deep, nearly level soil is on flood plains along streams. Most areas have rectified channels that are about 10 feet deep and 20 to 30 feet wide. Flooding occurs about once every 5 years. The surface is plane. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 30 inches, very dark grayish brown silt loam

Subsoil:
30 to 45 inches, very dark grayish brown silty clay loam with reddish brown mottles
45 to 80 inches, brown silty clay loam with olive brown and gray mottles

Important Soil Properties

Available water capacity: very high
Permeability: moderately slow
Drainage class: somewhat poorly drained
Runoff: low
Water table: at a depth of 2 to 4 feet from December through May
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Tinn soils. These soils are clayey throughout. Also included, near drainageways, are areas of Hopco soils that are frequently flooded.

This soil is used mostly as cropland. The main cultivated crops are wheat, corn, grain sorghum, and forage sorghum. Growing cover crops and soil-improving crops and leaving crop residue on or near the soil surface help to control erosion and improve soil tilth. Applications of fertilizer increase crop yields.

Several pecan orchards are in areas of this soil. Managing undesirable plants helps to maintain high production. Insect control also is a management concern.

Only a few areas of this soil are used as improved pasture. Coastal bermudagrass and common bermudagrass are the main grasses. Other suitable improved pasture species are fescue and switchgrass. These grasses may be overseeded with legumes, such as arrowleaf and white clovers, lespedeza,

singletary peas, and vetch, in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer increase yields. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Only small areas of this soil remain as native rangeland. The climax vegetation consists of Florida paspalum, Virginia wildrye, longleaf uniola, beaked panicum, little bluestem, indiangrass, and eastern gamagrass with an overstory of pecan, walnut, and cottonwood trees. Forage production is limited by the number of trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Hopco soil is in capability subclass IIw. The woodland ordination symbol is 6W.

Hn—Hopco silt loam, frequently flooded

This very deep, nearly level soil is on narrow flood plains along the smaller streams. Areas generally are flooded several times per year and have meandering channels that are 3 to 6 feet deep and 5 to 15 feet wide. Slopes are 0 to slightly over 1 percent.

Typical Profile

Surface layer:
0 to 8 inches, very dark grayish brown silt loam
8 to 30 inches, very dark gray silt loam

Subsoil:
30 to 45 inches, very dark gray silt loam with reddish brown mottles

Substratum:
45 to 80 inches, dark grayish brown silt loam with olive brown and dark gray mottles

Important Soil Properties

Available water capacity: very high
Permeability: moderately slow
Drainage class: somewhat poorly drained
Runoff: low
Water table: at a depth of 2 to 4 feet from December through May
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Frioton soils. These soils are calcareous. Also included are small areas of Hopco soils that are occasionally flooded.

This soil is used mainly as rangeland. The climax vegetation includes Florida paspalum, Virginia wildrye, longleaf uniola, beaked panicum, little bluestem, indiangrass, and eastern gamagrass with an overstory of pecan, walnut, bois d’arc, water oak, willow oak, elm, and cottonwood trees. Forage production depends upon the percent of the canopy. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, and switchgrass are suitable improved pasture species. Legumes, such as arrowleaf, ball, hop, red, or white clovers as well as lespedeza, vetch, and singletary peas, can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Because of the hazard of flooding, this soil is poorly suited to cropland and is unsuitable for urban uses.

The Hopco soil is in capability subclass Vw. The woodland ordination symbol is 6W.

HoB—Houston Black clay, 1 to 3 percent slopes

This very deep, very gently sloping soil is on uplands. The surface is convex. Areas are oblong or irregular in shape and range in size from 20 to 2,400 acres.

Typical Profile

Surface layer:
0 to 37 inches, black clay

Subsoil:
37 to 75 inches, very dark grayish brown clay with light olive brown and dark gray mottles

Substratum:
75 to 80 inches, dark yellowish brown clay with olive brown and dark gray mottles

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline

Shrink-swell potential: very high
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Burleson, Leson, Heiden, and Wilson soils. Burleson and Wilson soils are in nearly level, slightly concave areas. Burleson and Leson soils have a slightly acid surface layer. Wilson soils have a silt loam surface layer and a gray subsoil. Heiden soils have a very dark grayish brown surface layer

This soil is used mainly as cropland. The main crops are wheat, grain sorghum, and corn. Growing soil-improving crops and leaving plant residue on or near the soil surface help to control erosion and improve soil tilth and productivity. Terraces with protected outlets and contour farming help to control erosion.

Some areas are used as improved pasture. Coastal bermudagrass and common bermudagrass are the main grasses. Switchgrass, Kleingrass, fescue, weeping lovegrass, and introduced bluestems also are suitable improved pasture species. Legumes, such as arrowleaf, white, bur, and red clovers as well as vetch and singletary peas, can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management and weed control are needed.

A few areas of this soil are used as rangeland. The climax vegetation is a tall and mid grass prairie with scattered elm, hackberry, and bois d'arc trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Houston Black soil is in capability subclass IIe and in the Blackland range site.

HwC—Howe-Whitewright complex, 3 to 5 percent slopes

These moderately deep and shallow, gently sloping soils are on convex side slopes and ridges. Areas range from 10 to 700 acres in size.

This map unit is about 50 percent Howe soil, 30 percent Whitewright soil, and 20 percent similar soils and barren or nearly barren outcrops of chalk. The Howe soil is moderately deep. The Whitewright soil is shallow. These soils are too intricately mixed to be mapped separately at the scale used.

Typical Profile of the Howe Soil

Surface layer:
0 to 8 inches, dark grayish brown clay loam

Subsoil:
8 to 16 inches, grayish brown clay loam
16 to 27 inches, pale brown clay loam

Substratum:
27 to 40 inches, pale brown, brittle marl interbedded with chalk

Important Properties of the Howe Soil

Available water capacity: low
Permeability: moderate
Drainage class: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: severe
Hazard of wind erosion: slight

Typical Profile of the Whitewright Soil

Surface layer:
0 to 5 inches, grayish brown silty clay loam

Subsoil:
5 to 15 inches, brown clay loam with a few chalk fragments

Substratum:
15 to 25 inches, white, soft chalk

Important Properties of the Whitewright Soil

Available water capacity: very low
Permeability: moderate
Drainage class: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with these soils in mapping are small areas of Austin, Stephen, and Ferris soils. Austin soils are on ridges, have a very dark grayish brown surface

layer, and are moderately deep. Stephen soils have a black or very dark gray surface layer and are shallow. Ferris soils are strongly sloping, have clay textures, and are underlain by weathered shale.

This complex is used mainly as improved pasture. Coastal bermudagrass and common bermudagrass are the main grasses. Kleingrass, weeping lovegrass, indiangrass, and introduced bluestems also are suitable improved pasture species. Legumes, such as vetch, may be overseeded with these grasses in order to produce additional forage and add nitrogen to the soils. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management, weed control, and fertilization are needed.

Many areas of this complex are used as rangeland. The climax vegetation is a tall and mid grass prairie with scattered elm, oak, and bois d'arc trees. The low or very low available water capacity limits forage production. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Some areas of this complex are used as cropland. Yields are limited by the low or very low available water capacity. The depth of the soils restricts the type of erosion-control practices that can be used. A high content of calcium carbonate causes chlorosis in some plants.

These soils have several limitations that affect urban uses. The potential of both the Howe and Whitewright soils for shrinking and swelling with changes in moisture and the shallow depth to bedrock in the Whitewright soil are limitations that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. The depth to bedrock in both the Whitewright and Howe soils can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Howe soil is in capability subclass IIIe, and the Whitewright soil is in capability subclass IVe. The Howe soil is in the Chalky Ridge range site, and the Whitewright soil is in the Clay Loam range site.

IvA—Ivanhoe silt loam, 0 to 1 percent slopes

This very deep, nearly level soil is on the fourth terrace level of the Red River. The surface is plane.

Typical Profile

Surface layer:
0 to 5 inches, brown silt loam
5 to 13 inches, brown silt loam with reddish brown mottles

Subsoil:
13 to 17 inches, very dark grayish brown silty clay loam with reddish brown mottles
17 to 33 inches, very dark grayish brown clay with reddish brown mottles
33 to 51 inches, dark grayish brown clay
51 to 68 inches, grayish brown clay with strong brown mottles

Substratum:
68 to 84 inches, light gray clay with strong brown mottles

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: somewhat poorly drained
Runoff: very low
Water table: perched at a depth of 0.5 foot to 1.5 feet from November through April
Root zone: very deep
Soil reaction: moderately acid to neutral in the surface layer, moderately acid or slightly acid in the upper part of the subsoil, and neutral to moderately alkaline in the lower part of the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are Raino soils, which are on scattered pimple mounds, as well as Derly, Whakana, and Porum soils. In cultivated areas, the pimple mounds have been smoothed. Derly soils are in small areas that have a concave surface. Whakana and Porum soils are in gently sloping areas adjacent to natural drainageways.

This soil is used mainly as cropland and improved pasture. Wheat, grain sorghum, peanuts, and soybeans are the main cultivated crops. Growing soil-improving crops and leaving plant residue on or near the soil surface improve soil tilth. Applications of fertilizer increase crop yields.

Coastal bermudagrass, common bermudagrass, introduced bluestems, lovegrass, switchgrass, and indiangrass are suitable improved pasture grasses. Arrowleaf, ball, bur, button, hop, and white clovers as well as singletary peas are legumes that can be overseeded into these grasses in order to produce additional forage and add nitrogen to the soil. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

A few areas are used as rangeland. The climax

vegetation is a mid and tall grass prairie. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. Wetness and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations that must be considered when the foundations of buildings are designed. Low strength, wetness, and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Wetness and very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Ivanhoe soil is in capability subclass IIIw and in the Claypan Prairie range site.

KaA—Karma loam, 0 to 2 percent slopes

This very deep, nearly level and very gently sloping soil is on the first and second terrace levels of the Red River. Areas are oblong and range in size from 40 to about 1,000 acres. The surface is slightly convex.

Typical Profile

Surface layer:
0 to 8 inches, dark brown loam

Subsoil:
8 to 28 inches, reddish brown sandy clay loam
28 to 44 inches, yellowish red sandy clay loam
44 to 80 inches, yellowish red fine sandy loam

Important Soil Properties

Available water capacity: high
Permeability: moderate
Drainage class: well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid to slightly alkaline
Shrink-swell potential: low
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Okay soils. These soils are in nearly level areas and have a dark brown surface layer. Also included are areas of Karma soils with slopes of more than 2 percent.

This soil is used mainly as cropland; wheat, grain sorghum, peanuts, and soybeans are the main crops. A few areas are used for truck crops. Growing soil-improving crops and leaving plant residue on or near the soil surface help to control erosion and improve soil tilth. Applications of fertilizer increase crop yields.

Some areas are used as improved pasture. Coastal bermudagrass, common bermudagrass, introduced bluestems, bahiagrass, lovegrass, switchgrass, and indiangrass are suitable improved pasture species. Legumes, such as arrowleaf, ball, hop, and white clovers as well as vetch and singletary peas, can be overseeded into these grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer will improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and fertilization are management concerns.

A few areas of this soil are used as native pasture. The climax vegetation consists of oak, elm, hackberry, and hickory trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Most characteristics of this soil are favorable for building sites. This soil has some limitations that affect urban uses. Low strength is a limitation when streets and roads are constructed. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of untreated concrete.

The Karma soil is in capability subclass IIe. The woodland ordination symbol is 7A.

KaD2—Karma loam, 5 to 12 percent slopes, eroded

This very deep, strongly sloping soil is between the stream terraces and the flood plain of the Red River. Areas have V-shaped gullies that are 3 to 5 feet deep, 15 feet wide, and about 150 feet apart. Areas are long and narrow and range in size from 50 to 1,200 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 6 inches, brown loam

Subsoil:
6 to 18 inches, reddish brown sandy clay loam
18 to 36 inches, yellowish red sandy clay loam
36 to 73 inches, yellowish red loam

Important Soil Properties

Available water capacity: high
Permeability: moderate
Drainage class: well drained

Runoff: medium
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid to slightly alkaline
Shrink-swell potential: low
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with most areas of this soil in mapping are soils on circular mounds. These soils have a fine sandy loam surface layer about 26 inches thick.

Most areas of this soil are used as native pasture. The climax vegetation includes oak, elm, hackberry, and hickory trees that have an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, introduced bluestems, lovegrass, switchgrass, and indiangrass are suitable improved pasture species. Suitable legumes are arrowleaf, ball, hop, and white clovers as well as vetch and singletary peas. These can be overseeded into the grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management, weed control, and fertilization are needed.

This soil is not suited to cropland because of the slope and the severe hazard of water erosion.

Except for the slope, most characteristics of this soil are favorable for building sites. This soil has some limitations that affect urban uses. Low strength and the slope are limitations when streets and roads are constructed. Moderate permeability and the slope can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of untreated concrete.

The Karma soil is in capability subclass VIe. The woodland ordination symbol is 7A.

KoD—Konawa fine sandy loam, 5 to 8 percent slopes

This very deep, moderately sloping soil is on the third terrace level of the Red River. Areas are elongated and range in size from 40 to 300 acres.

Typical Profile

Surface layer:
0 to 14 inches, dark yellowish brown fine sandy loam

Subsoil:
14 to 36 inches, dark red sandy clay loam
36 to 48 inches, red sandy clay loam
48 to 80 inches, yellowish red fine sandy loam

Important Soil Properties

Available water capacity: high
Permeability: moderate
Drainage class: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid or slightly acid in the surface layer, strongly acid to neutral in the subsoil
Shrink-swell potential: low
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of gently sloping Bastrop soils.

This soil is used mainly as rangeland. The climax vegetation consists of a mid and tall grass savannah. Post oak and blackjack oak are the main trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Some areas are used as improved pasture. Coastal and common bermudagrass, bahiagrass, indiangrass, switchgrass, and weeping lovegrass are suitable improved pasture species. Pastures can be overseeded with legumes, such as arrowleaf, ball, hop, and white clovers, vetch, or singletary peas in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management, weed control, and fertilization are needed.

This soil is poorly suited to cropland because of the severe hazard of water erosion.

Most characteristics of this soil are favorable for building sites. This soil has some limitations that affect urban uses. Low strength is a limitation when streets and roads are constructed. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Konawa soil is in capability subclass IVe and in the Sandy Loam range site.

LaD—Lamar clay loam, 5 to 8 percent slopes

This very deep, moderately sloping soil is in areas between the nearly level uplands and the flood plains along Bois d’ Arc Creek. Past erosion has removed about 2 inches of the surface soil. Large marine shell fossils are common in most areas. Areas are irregular

in shape or elongated, follow the contour of the slope, and range in size from about 10 to 300 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 4 inches, dark brown clay loam

Subsoil:
4 to 37 inches, yellowish brown silty clay loam

Substratum:
37 to 65 inches, mottled yellowish brown, light brownish gray, and olive yellow silty clay loam

Important Soil Properties

Available water capacity: moderate
Permeability: moderate
Drainage class: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Crockett and Ferris soils. Crockett soils are on gently sloping foot slopes and narrow, gently sloping ridgetops. Ferris soils are adjacent to natural drainageways. Also included are some areas that have a few gullies.

This soil is used mainly as improved pasture. Coastal and common bermudagrass, indiangrass, switchgrass, Kleingrass, lovegrass, and introduced bluestems are suitable improved pasture species. Legumes, such as bur, button, red, and white clovers, singletary peas, and vetch, can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management, weed control, and fertilization are needed.

Some areas are used as rangeland. The climax vegetation consists of a mid and tall grass prairie. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Only a few areas of this soil are used as cropland because of the severe hazard of water erosion.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Lamar soil is in capability subclass IVe and in the Clay Loam range site.

LcA—Larton loamy fine sand, 0 to 2 percent slopes

This very deep, nearly level to gently sloping soil is on the second terrace level of the Red River. The surface is slightly convex.

Typical Profile

Surface layer:
0 to 14 inches, dark brown loamy fine sand

Subsurface layer:
14 to 23 inches, dark yellowish brown loamy fine sand

Subsoil:
23 to 36 inches, strong brown sandy clay loam
36 to 60 inches, reddish yellow sandy clay loam
60 to 80 inches, brownish yellow loam with red mottles

Important Soil Properties

Available water capacity: moderate
Permeability: moderate
Drainage class: well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: strongly acid to slightly acid
Shrink-swell potential: low
Hazard of water erosion: slight
Hazard of wind erosion: moderate

Included with this soil in mapping are small areas of Waskom, Raino, Derly, and Karma soils. Derly soils are in slightly concave areas. Raino soils are on pimple mounds. Karma soils are in gently sloping areas adjacent to drainageways. Waskom soils are in nearly level areas.

This soil is used mainly as cropland. Corn, peanuts, and soybean are the major crops. Growing soil-improving crops and leaving plant residue on or near the soil surface help to control erosion and improve soil tilth. Wind erosion can be a problem during certain times of the year if the soil is left unprotected. Proper fertilization increases yields. Additions of lime may be needed to correct soil acidity.

Some areas are used as improved pasture. Coastal bermudagrass and common bermudagrass are the

main pasture grasses. Bahiagrass and lovegrass also are suitable improved pasture species. Legumes, such as crimson or hop clovers and vetch, can be overseeded into pastures in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management, weed control, and timely fertilization are needed.

A few areas are used as native pasture. The climax vegetation includes red oak, blackjack oak, post oak, sweetgum, elm, and hickory trees with an understory of grasses. Some areas have been planted to pine. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has some limitations that affect urban uses. Most conditions of this soil are favorable for buildings and for streets and roads. Cutbanks cave easily, making shallow excavations difficult. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of untreated concrete.

The Larton soil is in capability subclass IIIe. The woodland ordination symbol is 8S.

LeB—Leson clay, 1 to 3 percent slopes

This very deep, very gently sloping soil is on uplands. Gilgai microrelief is in the few remaining undisturbed areas. Areas are irregular in shape and range in size from 20 to 700 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 14 inches, black clay
14 to 36 inches, black clay with yellowish brown mottles

Subsoil:
36 to 48 inches, very dark grayish brown clay
48 to 70 inches, mottled dark grayish brown and brown clay

Substratum:
70 to 80 inches, mottled brown and yellowish brown, stratified clay

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly acid to moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Burleson, Houston Black, and Wilson soils. Houston Black soils are calcareous. Burleson soils are in nearly level areas. Wilson soils are in slightly concave areas and have a silt loam surface layer.

This soil is used mainly as cropland. Wheat and grain sorghum are the main crops. Corn and cotton are grown in a few areas. Growing soil-improving crops and leaving plant residue on or near the soil surface help to control erosion and improve soil tilth. Terraces with stable outlets help to control water erosion. Applications of fertilizer increase yields.

Some areas are used as improved pasture. Coastal bermudagrass, common bermudagrass, indiangrass, switchgrass, bahiagrass, fescue, Kleingrass, and introduced bluestems are suitable improved pasture species. Legumes, such as arrowleaf, ball, hop, and white clovers as well as vetch and singletary peas, can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer increase the quantity and improve the quality of the forage. Proper grazing management and weed control are needed.

Only a few areas are used as rangeland. The climax vegetation consists of a tall and mid grass prairie with scattered elm, hackberry, bois d'arc, and locust trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Leson soil is in capability subclass IIe and in the Blackland range site.

LvB—Lewisville silty clay, 1 to 3 percent slopes

This very deep, very gently sloping soil is on uplands. Areas are oval or irregular in shape and range in size from 20 to 100 acres.

Typical Profile

Surface layer:
0 to 14 inches, very dark grayish brown silty clay

Subsoil:
14 to 28 inches, dark yellowish brown silty clay
28 to 50 inches, yellowish brown silty clay
50 to 80 inches, brownish yellow silty clay

Important Soil Properties

Available water capacity: high
Permeability: moderate
Drainage class: well drained
Runoff: low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Lamar, Howe, Normangee, and Ferris soils. Lamar soils are strongly sloping. Normangee soils are in the higher positions. Howe soils are underlain by chalk. Ferris soils are strongly sloping and are underlain by shale with clay texture.

This soil is used mainly as cropland; wheat and grain sorghum are the main crops. Plant residue left on or near the soil surface helps to control erosion and improve soil tilth. Applications of fertilizer increase yields. Terraces and contour farming help to control erosion.

Some areas are used as improved pasture. Coastal bermudagrass, common bermudagrass, fescue, Kleingrass, lovegrass, indiangrass, switchgrass, and introduced bluestems are grown in these areas. Legumes, such as arrowleaf, bur, button, red, and white clovers as well as singletary peas and vetch, can be overseeded into the grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Proper grazing management, weed control, and fertilization are needed.

A few areas are used as rangeland. The climax vegetation consists of a tall and mid grass prairie with scattered elm, hackberry, and bois d’arc trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Lewisville soil is in capability subclass IIe and in the Clay Loam range site.

MoD2—Morse clay, 5 to 12 percent slopes, eroded

This very deep, strongly sloping soil is in areas on the third terrace level of the Red River. These areas have V-shaped gullies and many rills. About 50 to 75 percent of the surface layer has been removed. Areas range from 10 to 140 acres in size.

Typical Profile

Surface layer:
0 to 4 inches, dark brown clay

Subsoil:
4 to 16 inches, yellowish red clay
16 to 28 inches, red clay

Substratum:
28 to 80 inches, dark red clay

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: very high
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Whakana and Porum soils. These soils are adjacent to natural drainageways. Also included are areas of Morse soils with an uneroded surface layer and areas of Morse soils in which all of the surface layer has been removed by erosion.

Most areas of this soil are used as native pasture. The climax vegetation consists mainly of mixed hardwood trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas of this soil are used as improved pasture. Coastal bermudagrass is the main improved

pasture species grown on this soil. Control of grazing, weed control, and fertilization are management concerns.

This soil is unsuitable for cropland because of the severe hazard of water erosion.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Morse soil is in capability subclass VIe. The woodland ordination symbol is 6T.

Mu—Muldrow clay loam, rarely flooded

This very deep, nearly level soil is in long, narrow areas on the first terrace level of the Red River. Shallow drainage channels remove excess water from most of the unit. Areas average about 400 acres in size. The surface is concave. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 6 inches, very dark grayish brown clay loam
6 to 16 inches, very dark brown clay loam with reddish brown mottles

Subsoil:
16 to 24 inches, very dark grayish brown clay with reddish brown mottles
24 to 60 inches, very dark grayish brown clay with reddish brown and dark gray mottles
60 to 80 inches, dark gray clay loam with yellowish brown, light gray, and dark reddish brown mottles

Important Soil Properties

Available water capacity: very high
Permeability: very slow
Drainage class: somewhat poorly drained
Runoff: negligible
Water table: within a depth of 2 feet from September through March
Root zone: very deep
Soil reaction: strongly acid or moderately acid in the surface layer, slightly acid to moderately alkaline in the subsoil
Shrink-swell potential: moderate in the surface layer and high in the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Derly and Raino soils. Derly soils are in the slightly higher positions. Raino soils are on scattered pimple mounds. Also included are areas of Muldrow soils that are ponded during periods of high rainfall.

This soil is used mainly as improved pasture. Bahiagrass, common bermudagrass, coastal bermudagrass, fescue, switchgrass, and Kleingrass are the main pasture grasses. Legumes, such as bur, button, and white clovers, and singletary peas, can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Management concerns include controlled grazing, weed control, and fertilization.

Some areas of this soil are used as cropland. Wheat, soybeans, and grain sorghum are the main crops. Wetness may limit the type of crop grown on this soil. Improving soil tilth and maintaining productivity are management concerns.

A few areas of this soil are used as native pasture. The climax vegetation includes mixed hardwood trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Muldrow soil is in capability subclass IIw. The woodland ordination symbol is 4W.

NoB—Normangee clay loam, 1 to 3 percent slopes

This very deep, very gently sloping soil is on the side slopes of low ridges. Areas are oblong, follow the contour of the slope, and range in size from 10 to more than 100 acres.

Typical Profile

Surface layer:
0 to 6 inches, dark grayish brown clay loam

Subsoil:
6 to 21 inches, dark brown clay with reddish brown and dark grayish brown mottles
21 to 39 inches, dark brown clay with dark yellowish brown, reddish brown, and yellowish red mottles
39 to 55 inches, mottled olive yellow, dark olive gray, gray, and reddish brown clay

Substratum:
55 to 80 inches, olive gray clay with light olive brown and yellowish brown mottles

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly acid or neutral in the surface layer, moderately acid to moderately alkaline in the subsoil
Shrink-swell potential: moderate in the surface layer and high in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Wilson and Crockett soils. Wilson soils are in slightly concave areas. Crockett soils have a loam surface layer.

This soil is used mainly as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, introduced bluestems, Kleingrass, indiangrass, switchgrass, and lovegrass are suitable improved pasture species. Arrowleaf, ball, bur, button, crimson, hop, and white clovers as well as vetch and singletary peas are legumes that can be grown in pastures in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and fertilization are management concerns.

Some areas are used as cropland. Wheat, soybeans, and grain sorghum are the main crops (fig. 13). Growing soil-improving crops and leaving plant residue on or near the soil surface help to control erosion and improve soil tilth. Terraces with stable outlets help to control erosion. Applications of fertilizer increase crop yields.

A few areas are used as rangeland. The climax vegetation consists of a tall and mid grass prairie with scattered post oak and bois d'arc trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Normangee soil is in capability subclass IIIe and in the Claypan Prairie range site.

NoC2—Normangee clay loam, 2 to 5 percent slopes, eroded

This very deep, gently sloping soil is on the side slopes of ridges. Areas are oblong, follow the contour of the slope, and range in size from 20 to more than 200 acres. Nearly all of areas of this soil formerly were cultivated. Erosion has exposed the clayey subsoil on about 25 percent of the acreage of this map unit. About 65 percent of the map unit has an eroded, loamy surface layer less than 5 inches thick. The rest of the unit is not eroded. There are a few active gullies, which are 2 to 4 feet deep and 40 to 60 feet wide. The surface is convex.

Typical Profile

Surface layer:
0 to 3 inches, dark brown clay loam

Subsoil:
3 to 29 inches, dark grayish brown clay with yellowish brown and reddish brown mottles
29 to 55 inches, mottled very dark grayish brown and yellowish brown clay

Substratum:
55 to 70 inches, mottled gray, brownish yellow, and olive gray clay

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly acid or neutral in the surface layer, moderately acid to moderately alkaline in the subsoil
Shrink-swell potential: moderate in the surface layer and high in the subsoil
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Crockett soils. These soils are on ridges and have a loam surface layer.

Nearly all areas of this soil were cultivated in the past and are now used mainly as improved pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, introduced bluestems, Kleingrass, indiangrass, switchgrass, and weeping lovegrass are suitable grasses. Arrowleaf, ball, bur, button, crimson, hop, and white clovers and lespedeza, vetch, and singletary peas are suitable legumes. When grown in improved pastures, they will produce additional forage and add nitrogen to the soil. Applications of fertilizer help to maintain production of high-quality forage. Management concerns include controlled grazing, weed control, and maintenance of soil fertility.

Some areas of this soil are used as rangeland. The climax vegetation is a mid and tall grass prairie with scattered post oak and bois d'arc trees. Many of these areas are abandoned cropland fields with grasses of low quality. Forage production is low unless the areas are reseeded to high-quality grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas of this soil are used as cropland. The soil is poorly suited to cultivation because of past erosion and the severe hazard of water erosion.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Normangee soil is in capability subclass IVe and in the Claypan Prairie range site.

Nw—Norwood silt loam, rarely flooded

This very deep, nearly level soil is on flood plains, mostly along the Red River. The soil has not been flooded since the construction of Lake Texoma in the

Figure 13.—Grain sorghum and soybeans on a terraced field in an area of Normangee clay loam, 1 to 3 percent slopes.

1940's. Areas are oblong and parallel large drainageways that flow into the river. They range from 75 to 500 acres in size. The surface is convex. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 9 inches, brown silt loam

Underlying material:
9 to 60 inches, reddish brown silty clay loam

Important Soil Properties

Available water capacity: very high
Permeability: moderate
Drainage class: well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: low
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Belk, Redlake, and Severn soils. Belk and Redlake soils are in slightly concave areas. Severn soils are on the slightly higher ridges.

Nearly all areas of this soil are used as cropland. Grain sorghum, corn, soybeans, and wheat are the main crops. Alfalfa is grown for hay in some areas. Growing soil-improving crops and leaving plant residue on or near the soil surface improve soil tilth. Applications of fertilizer increase crop yields.

Some areas are used as improved pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, fescue, Kleingrass, and switchgrass are the main pasture plants. Arrowleaf, black medic, ball, bur, button, hop, red, and white clovers as well as lespedeza, singletary peas, and vetch are suitable legumes that will produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and maintenance of soil fertility are management concerns.

A few areas are used as native pasture. The climax vegetation consists of pecan, cottonwood, elm, oak, and hackberry trees with an understory of tall and mid grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for most urban uses because of the hazard of flooding.

The Norwood soil is in capability class I. The woodland ordination symbol is 9A.

OkA—Okay loam, 0 to 1 percent slopes

This very deep, nearly level soil is on the first and second terrace levels of the Red River. Areas are oblong and range in size from 50 to about 1,000 acres. The surface is slightly convex.

Typical Profile

Surface layer:
0 to 8 inches, dark brown loam
8 to 14 inches, dark reddish brown loam

Subsoil:
14 to 24 inches, dark reddish brown clay loam
24 to 38 inches, yellowish red clay loam
38 to 65 inches, strong brown loam

Important Soil Properties

Available water capacity: high
Permeability: moderate
Drainage class: well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid or slightly acid in the surface layer, strongly acid to neutral in the subsoil
Shrink-swell potential: low
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Bastrop, Karma, and Waskom soils. Bastrop soils are on gently sloping ridges. Karma soils are on gently sloping, low ridges. Waskom soils are in positions similar to those of the Okay soil.

This soil is used mainly as cropland. Corn, grain sorghum, soybeans, peanuts (fig. 14), and wheat are the main crops. Growing soil-improving crops and leaving plant residue on or near the soil surface improve soil tilth. Applications of fertilizer increase yields.

Some areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, introduced bluestems, fescue, indiangrass, switchgrass, and lovegrass are suitable improved pasture species. Arrowleaf, ball, hop, and white clovers as well as singletary peas, lespedeza, and vetch are legumes that produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and maintenance of soil fertility are management concerns.

Only a few areas of this soil are used as rangeland.

Figure 14.—Irrigated peanuts in an area of Okay loam, 0 to 1 percent slopes.

The climax vegetation consists of a tall and mid grass prairie with scattered oak trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has some limitations that affect urban uses. Most soil features are favorable for the foundations of buildings. Low strength is a limitation when streets and roads are constructed. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Okay soil is in capability class I and in the Sandy Loam range site.

Om—Oklared-Kiomatia complex, occasionally flooded

These very deep, nearly level to gently undulating soils are on flood plains, mostly along the Red River. The soils are flooded about once every 10 years. The landscape is made up of a series of long, narrow ridges, swales, and benches. Areas are 6 to 12 feet higher than normal river flow. They range in size from 35 to 600 acres. Slopes are 0 to 5 percent.

This unit is about 55 percent Oklared soil, 35 percent Kiomatia soil, and 10 percent other soils. The Oklared soil is at the higher elevations, farther from the river channel. The Kiomatia soil is on long, narrow

ridges, in areas closer to the river channel. These soils are too intricately mixed to be separated at the scale of mapping used.

Typical Profile of the Oklared Soil

Surface layer:
0 to 8 inches, reddish brown fine sandy loam

Underlying material:
8 to 60 inches, reddish brown fine sandy loam

Important Properties of the Oklared Soil

Available water capacity: moderate
Permeability: moderately rapid
Drainage class: well drained
Runoff: negligible
Water table: at a depth of 3.5 to 50 feet from January through July
Root zone: very deep
Soil reaction: slightly alkaline or moderately alkaline
Shrink-swell potential: low
Hazard of water erosion: slight
Hazard of wind erosion: slight

Typical Profile of the Kiomatia Soil

Surface layer:
0 to 9 inches, reddish brown loamy fine sand

Underlying material:
9 to 60 inches, reddish brown fine sand

Important Properties of the Kiomatia Soil

Available water capacity: moderate
Permeability: rapid
Drainage class: well drained
Runoff: negligible
Water table: at a depth of 3.5 to 5.0 feet from January through July
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: low
Hazard of water erosion: slight
Hazard of wind erosion: moderate

Included with these soils in mapping are small areas of nearly level Severn soils.

Many areas of this complex are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, and switchgrass are the main forage species. Arrowleaf, ball, bur, button, and hop clovers as well as lespedeza, singletary peas, and vetch are legumes that can be grown in order to produce additional forage and add nitrogen to the soils. Applications of fertilizer help to maintain production. Controlled grazing, weed control, and maintenance of soil fertility are management concerns.

A few areas of this complex are used as cropland. Droughtiness in the Kiomatia soil limits productivity. Growing soil-improving crops and leaving crop residue on the surface will improve soil tilth and reduce the hazard of erosion.

Some areas of these soils are used as native pasture. The climax vegetation consists of cottonwood and hackberry trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

These soils are unsuitable for urban uses because of the hazard of flooding.

In areas of the Oklared soil, the capability subclass is IIw and the woodland ordination symbol is 9A. In areas of the Kiomatia soil, the capability subclass is IIIs and the woodland ordination symbol is 9W.

Or—Orthents, loamy

These very deep, loamy soils are in mined-out sand and gravel pits. The soil material has been smoothed in most areas. These soils are on lower parts of the landscape, mainly on stream terraces. Slopes are 1 to 8 percent.

These soils are mostly loamy and have varying amounts of sand and gravel. Because they are in the lower areas, they are subject to ponding by runoff.

Included with these soils in mapping are small pits and lower wet areas that hold water most of the year. Also included are small areas that have clayey soil material.

This unit is used mainly for pasture. The main grasses are common bermudagrass and coastal bermudagrass. Uneven topography and low fertility are limitations. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth. Restricted drainage can be a limitation in the included areas.

These soils are not suited to crop production. The uneven topography and ponding are the main limitations affecting crop growth. Restricted drainage is a limitation in the included areas.

These soils are unsuitable for urban and recreational uses. Ponding, restricted drainage, and clayey textures are limitations in the Orthents and in the included areas.

The Orthents are not assigned to a capability subclass, range site, or woodland ordination symbol.

PoC—Porum loam, 2 to 5 percent slopes

This very deep, gently sloping soil is between the third and fourth terrace levels of the Red River. Areas are oblong or long and narrow and range in size from 50 to about 1,200 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 5 inches, yellowish brown loam

Subsoil:
5 to 16 inches, yellowish red clay loam
16 to 30 inches, mottled red, dark yellowish brown, grayish brown, and gray silty clay loam
30 to 50 inches, mottled light gray, yellowish brown, and strong brown silty clay loam
50 to 80 inches, mottled strong brown, brown, dusky red, and light gray clay loam

Important Soil Properties

Available water capacity: high
Permeability: slow
Drainage class: moderately well drained
Runoff: medium
Water table: perched at a depth of 2 to 3 feet from December through April
Root zone: very deep
Soil reaction: very strongly acid to slightly alkaline
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Ivanhoe and Whakana soils. Ivanhoe soils are in nearly level areas. Whakana soils have a sandy clay loam subsoil. Also included are areas of Porum soils from which nearly all of the topsoil has been removed by erosion or that have gullies several feet deep.

This soil is used mainly as improved pasture. Coastal bermudagrass, common bermudagrass, introduced bluestems, bahiagrass, indiangrass, switchgrass, and weeping lovegrass are suitable improved pasture species. Arrowleaf, ball, crimson, hop, and white clovers as well as lespedeza, singletary peas, and vetch are legumes that can be grown in improved pastures in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and proper fertilization are management concerns.

Only a few areas of this soil are used for cultivated crops. The hazard of water erosion is a limitation.

Some areas of this soil are used as native pasture. The climax vegetation consists of mixed hardwood trees with an understory of grasses. A few areas have been planted to loblolly pine. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Slow permeability and wetness can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Porum soil is in capability subclass IIIe. The woodland ordination symbol is 6C.

PoD—Porum loam, 5 to 12 percent slopes

This very deep, strongly sloping soil is between the third and fourth terrace levels of the Red River. Areas are oblong, follow the contour of the slope, and range in size from 60 to 600 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 6 inches, brown loam

Subsoil:
6 to 16 inches, red clay loam
16 to 34 inches, red silty clay loam with light gray mottles
34 to 64 inches, mottled yellowish brown and yellowish red silty clay loam

Substratum:
64 to 80 inches, mottled red, yellowish red, and grayish brown clay loam

Important Soil Properties

Available water capacity: high
Permeability: slow
Drainage class: moderately well drained
Runoff: high
Water table: perched at a depth of 2 to 3 feet from December through April
Root zone: very deep
Soil reaction: very strongly acid to moderately acid
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: severe

Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Whakana soils. These soils have a sandy clay loam subsoil.

Most areas of this soil are used as native pasture. The climax vegetation consists of mixed hardwood trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is poorly suited to cultivation because of the severe hazard of water erosion.

The severe hazard of water erosion makes establishment of improved pastures difficult. Bahiagrass, coastal bermudagrass, common bermudagrass, introduced bluestems, lovegrass, switchgrass, and indiangrass are suitable improved pasture species. Legumes, such as arrowleaf, ball, crimson, hop, and white clovers as well as lespedeza, singletary peas, and vetch, can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Slow permeability and wetness can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Porum soil is in capability subclass VIe. The woodland ordination symbol is 6C.

Re—Redlake clay, rarely flooded

This very deep, nearly level soil is on flood plains, mainly along the Red River. The soil has not been flooded since the construction of Lake Texoma in the 1940’s. Areas are long, follow the contour, and range in size from 50 to more than 1,000 acres. The surface is plane or slightly concave. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 6 inches, dark reddish brown clay

Subsoil:
6 to 30 inches, dark reddish brown clay
30 to 55 inches, reddish brown clay

Substratum:
55 to 80 inches, yellowish red clay loam

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly alkaline or moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Belk and Severn soils. Belk soils are in positions similar to those of the Redlake soil. They have a loamy substratum. Severn soils are on long, narrow ridges. Also included are areas of Redlake soils that have a thin surface layer of silty clay loam.

This soil is used mainly as cropland. Wheat, soybeans, and grain sorghum are the main crops. Alfalfa is grown for hay in a few areas. Improving soil tilth is the main management concern. Applications of fertilizer increase yields.

Some areas of this soil are used as improved pasture. Coastal bermudagrass and common bermudagrass are the main forage species. Fescue, bahiagrass, Kleingrass, and switchgrass are other suitable improved pasture species. Bur, button, and white clovers as well as singletary peas are legumes that can be grown in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and maintenance of soil fertility are management concerns.

Only a few areas of this soil are used as native pasture. The climax vegetation consists of red oak, sweetgum, elm, pecan, green ash, cottonwood, and hackberry trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Redlake soil is in capability subclass IIIw. The woodland ordination symbol is 7W.

Se—Severn silt loam, rarely flooded

This very deep, nearly level soil is on flood plains, mainly along the Red River. The soil has not been flooded since the construction of Lake Texoma in the

1940's. Areas are oblong and parallel the Red River channel. They range from 20 to 1,700 acres in size. Slopes are 0 to 5 percent. They are dominantly less than 1 percent.

Typical Profile

Surface layer:
0 to 7 inches, reddish brown silt loam

Underlying material:
7 to 24 inches, reddish brown silt loam
24 to 60 inches, reddish brown, stratified very fine sandy loam and fine sandy loam

Important Soil Properties

Available water capacity: very high
Permeability: moderately rapid
Drainage class: well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly alkaline or moderately alkaline
Shrink-swell potential: low
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Oklared and Norwood soils. Oklared soils are on low ridges. Norwood soils are in nearly level areas. Also included are a few areas of occasionally flooded Severn soils adjacent to the river channel.

This soil is used mainly as cropland. Grain sorghum, soybeans, wheat, and peanuts are the main crops. Growing soil-improving crops and leaving plant residue on or near the soil surface help to control erosion and improve soil tilth and productivity. Applications of fertilizer increase crop yields.

Some areas of this soil are used as improved pasture. Coastal bermudagrass and common bermudagrass are the main forage species. Bahiagrass, fescue, Kleingrass, and switchgrass also are suitable improved pasture species. Legumes, such as arrowleaf, ball, bur, button, hop, red, and white clovers as well as singletary peas, can be overseeded into improved pastures in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and proper fertilization are management concerns.

Only a few areas of this soil are used as native pasture. The climax vegetation consists of cottonwood, sycamore, hackberry, and pecan trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Severn soil is in capability class I. The woodland ordination symbol is 9A.

ShB—Stephen silty clay, 1 to 3 percent slopes

This very shallow or shallow, very gently sloping soil is on upland ridges and side slopes. Areas are irregular in shape and range in size from 10 to 400 acres.

Typical Profile

Surface layer:
0 to 8 inches, very dark gray silty clay
8 to 14 inches, dark grayish brown silty clay

Underlying material:
14 to 20 inches, white and very pale brown, platy chalk

Important Soil Properties

Available water capacity: very low
Permeability: moderately slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: very shallow or shallow
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Austin and Dalco soils. Austin soils are on ridges, are moderately deep to bedrock, and have a silty clay loam surface layer. Dalco soils are in positions similar to those of the Stephen soil and are moderately deep to bedrock.

This soil is used mainly as cropland. Grain sorghum and wheat are the main crops. Plant residue left on or near the soil surface helps to control erosion and maintain soil tilth and productivity. The depth to bedrock can limit the type of erosion-control practices that are used.

Some areas of this soil are used as improved pasture. Bermudagrass is the main improved pasture species. Introduced bluestems, Kleingrass, lovegrass, and indiangrass are other suitable species. Vetch is a legume that can be grown in order to produce additional forage and add nitrogen to the soil. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Only a few areas of this soil are used as rangeland. The climax vegetation consists of a mid grass prairie. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture and the depth to bedrock are limitations that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. The depth to bedrock can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Stephen soil is in capability subclass IIIe and in the Chalky Ridge range site.

SrC—Stephen-Rock outcrop complex, 2 to 5 percent slopes

This complex consists of a shallow or very shallow, gently sloping Stephen soil intermingled with Rock outcrop. It is on ridges and the side slopes of ridges near drainageways. Outcrops of chalk are in scattered areas throughout the unit. Areas are oblong and range in size from 20 to more than 120 acres.

This unit is about 70 percent Stephen soil, 15 percent Rock outcrop, and 15 percent included soils. The Stephen soil is about 12 inches deep over chalk. Rock outcrop consists of barren or nearly barren chalk. Stephen and similar soils dominate the complex and together with Rock outcrop are in patterns too intricate to be separated at the scale of mapping used.

Typical Profile of the Stephen Soil

Surface layer:
0 to 8 inches, very dark brown silty clay
8 to 12 inches, dark grayish brown silty clay

Substratum:
12 to 20 inches, white and pale brown, platy chalk

Important Properties of the Stephen Soil

Available water capacity: very low
Permeability: moderately slow
Drainage class: well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: very shallow or shallow
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included in this complex in mapping are small areas of Austin and Dalco soils. Austin soils are on foot slopes. Dalco soils are in nearly level areas near the head of drainageways.

This complex is used mainly as rangeland. The climax vegetation consists of a mid grass prairie. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Some areas of this complex are used as improved pasture. The depth to bedrock limits forage production. Bermudagrass is the main forage species. Kleingrass, lovegrass, indiangrass, and introduced bluestems are other suitable improved pasture species. Vetch is a legume that can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. Controlled grazing, weed control, and maintenance of soil fertility are management concerns.

Only a few areas of this complex are used as cropland. The depth to bedrock limits yields and restricts the type of erosion-control practices that can be applied.

This complex has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture and the depth to bedrock are limitations that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. The depth to bedrock can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Stephen soil is in capability subclass IVe and in the Chalky Ridge range site. Rock outcrop is in capability class VIII and is not assigned a range site.

SvB—Stephenville fine sandy loam, 1 to 3 percent slopes

This moderately deep, very gently sloping soil is on uplands. Areas are somewhat oval and range in size from 10 to 50 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 7 inches, dark brown fine sandy loam

Subsoil:
7 to 20 inches, yellowish red sandy clay loam with dark red mottles
20 to 30 inches, yellowish red sandy clay loam with yellowish brown mottles

Substratum:
30 to 40 inches, stratified, red sandstone with brownish yellow streaks

Important Soil Properties

Available water capacity: low
Permeability: moderate
Drainage class: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: strongly acid to slightly acid in the surface layer, very strongly acid to moderately acid in the subsoil
Shrink-swell potential: low
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are Aubrey soils, Rock outcrop, and a shallow soil that is similar to the Stephenville soil. Aubrey soils are in positions similar to those of the Stephenville soil and are underlain by shale with clay texture. The Rock outcrop, which is sandstone, and the shallow soil are in the more sloping areas.

This soil is used mainly as rangeland. Most areas were cultivated in the past but have since been allowed to return to native vegetation. Trees have been removed from nearly all areas. The native vegetation consists of post oak, blackjack oak, hickory, and elm trees with an understory of bluestems, indiangrass, and lovegrass. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

A few areas are cultivated or used as improved pasture. Most cultivated areas are used for hay. Bahiagrass, common bermudagrass, coastal bermudagrass, introduced bluestems, lovegrass, indiangrass, and switchgrass are suitable improved pasture grasses. Arrowleaf, ball, hop, and white clovers as well as lespedeza, singletary peas, and vetch are legumes that can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. When applied to cultivated areas and improved pastures, lime will correct soil acidity. Applications of fertilizer increase yields. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

This soil has some limitations that affect urban uses. Most conditions of this soil are favorable for building sites and for streets and roads. The depth to bedrock can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Stephenville soil is in capability subclass IIe and in the Sandy Loam range site.

Tc—Tinn clay, occasionally flooded

This very deep, nearly level soil is on broad flood plains along streams, mainly along the North Sulphur River. The soil is subject to flooding once every 20 to 30 years. The surface is plane. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 8 inches, black clay
8 to 46 inches, very dark gray clay

Subsoil:
46 to 80 inches, dark gray clay

Important Soil Properties

Available water capacity: very high
Permeability: very slow
Drainage class: moderately well drained
Runoff: low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly alkaline or moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Frioton and Hopco soils. These soils are on alluvial fans near the mouths of creeks that drain into the North Sulphur River. Also included are a few shallow sloughs that carry floodwater when the main stream channel leaves its banks.

This soil is used mainly as cropland. Corn, grain sorghum, soybeans, and wheat are the main crops. Alfalfa and forage sorghum are grown for hay in some areas. Growing soil-improving crops and leaving plant residue on or near the soil surface improve soil tilth and maintain productivity. Applications of fertilizer increase yields.

Some areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, Kleingrass, switchgrass, and fescue are suitable improved pasture species. White, bur, and button clovers as well as singletary peas can be grown in improved pastures in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and proper fertilization are management concerns.

Only a few areas of this soil are used as native pasture. The climax vegetation consists of mixed

hardwood trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Tinn soil is in capability subclass IIw. The woodland ordination symbol is 2W.

Tf—Tinn clay, frequently flooded

This very deep, nearly level soil is on broad flood plains along streams. On the average, the soil is subject to flooding more than once a year over a 10-year period. The surface is plane. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 10 inches, black clay
10 to 50 inches, very dark gray clay

Subsoil:
50 to 80 inches, dark gray clay with dark grayish brown mottles

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well drained
Runoff: low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly alkaline or moderately alkaline
Shrink-swell potential: high
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Dela, Frioton, and Hopco soils. Frioton soils are less clayey than the Tinn soil and are on natural levees along stream channels and alluvial fans bordering hillsides. Dela and Hopco soils are loamy and are on alluvial fans near the mouths of creeks that drain into Bois d’Arc Creek.

Most areas of this soil are used as native pasture. The climax vegetation consists of mixed hardwood trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Some areas of this soil have been cleared and are used as improved pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, Kleingrass, switchgrass, and fescue are suitable grasses. Legumes, such as bur, button, and white clovers as well as singletary peas, can be grown with pasture grasses in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and proper fertilization are management concerns.

This soil is unsuitable for cropland and for urban uses because of the hazard of flooding.

The Tinn soil is in capability subclass Vw. The woodland ordination symbol is 2W.

VtC—Vertel clay, 2 to 5 percent slopes

This moderately deep, gently sloping soil is on upland ridges and side slopes. Areas are long and narrow and range in size from 10 to 200 acres.

Typical Profile

Surface layer:
0 to 9 inches, very dark grayish brown clay

Subsoil:
9 to 20 inches, dark grayish brown clay
20 to 36 inches, dark grayish brown clay with olive brown mottles

Substratum:
36 to 55 inches, mottled dark gray and yellowish brown, stratified, weathered shale

Important Soil Properties

Available water capacity: low
Permeability: very slow
Drainage class: well drained
Runoff: high
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: neutral to moderately alkaline
Shrink-swell potential: very high
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Birome and Heiden soils. Birome soils are underlain by sandstone. Heiden soils are on foot slopes.

This soil is used mainly as rangeland. The climax plant community is a mid and short grass prairie with scattered elm, hackberry, and bois d’arc trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Because of the severe hazard of water erosion, only a few areas of this soil are used as cropland. Wheat is the main crop. Growing soil-improving crops and incorporating plant residue into the soil help to control erosion and maintain tilth and productivity.

Some areas of this soil are used as improved

pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, fescue, Kleingrass, indiangrass, switchgrass, and introduced bluestems are suitable improved pasture species. Arrowleaf, ball, bur, button, hop, and white clovers as well as singletary peas, lespedeza, and vetch are legumes that can be grown in improved pastures in order to produce additional forage and add nitrogen to the soil. Controlled grazing, weed control, and proper fertilization are management concerns.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability and the depth to bedrock can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Vertel soil is in capability subclass IVe and in the Eroded Blackland range site.

VtD—Vertel clay, 5 to 8 percent slopes

This moderately deep, moderately sloping soil is on upland ridges and side slopes. Areas are long and narrow and range in size from 20 to 200 acres.

Typical Profile

Surface layer:
0 to 5 inches, very dark grayish brown clay

Subsoil:
5 to 28 inches, light olive brown clay
28 to 38 inches, olive brown clay with gray mottles

Substratum:
38 to 60 inches, mottled gray and yellowish brown shale

Important Soil Properties

Available water capacity: low
Permeability: very slow
Drainage class: well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: neutral to moderately alkaline
Shrink-swell potential: very high
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of gently sloping Heiden soils.

Most areas of this soil are used as rangeland. The climax plant community is a mid and short grass prairie with scattered elm, hackberry, and bois d’arc trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is poorly suited to cropland because of the severe hazard of water erosion.

Some areas of this soil are used as improved pasture. Bahiagrass, coastal bermudagrass, common bermudagrass, fescue, indiangrass, switchgrass, and introduced bluestems are suitable improved pasture species. Arrowleaf, ball, bur, button, hop, and white clovers as well as lespedeza, singletary peas, and vetch are legumes that can be grown in improved pastures in order to produce additional forage and add nitrogen to the soil. Controlled grazing, weed control, and proper fertilization are management concerns.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for shrinking and swelling with changes in moisture are limitations when streets and roads are constructed. Very slow permeability and the depth to bedrock can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Vertel soil is in capability subclass VIe and in the Eroded Blackland range site.

WaA—Waskom silt loam, 0 to 1 percent slopes

This very deep, nearly level soil is on the second terrace level of the Red River. Areas range from 50 to 1,000 acres in size. The surface is plane. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 16 inches, very dark brown silt loam

Subsoil:
16 to 24 inches, very dark grayish brown clay loam with reddish brown and dark yellowish brown mottles
24 to 36 inches, dark yellowish brown clay loam with reddish brown mottles

36 to 60 inches, mottled brown, grayish brown, and yellowish brown clay loam
60 to 80 inches, mottled yellowish brown and grayish brown clay loam

Important Soil Properties

Available water capacity: high
Permeability: moderately slow
Drainage class: moderately well drained
Runoff: negligible
Water table: at a depth of 1.5 to 2.5 feet from December through May
Root zone: very deep
Soil reaction: moderately acid to neutral in the surface layer, slightly acid to slightly alkaline in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Okay soils. These soils are in slightly convex areas. Also included are soils that are similar to the Waskom soil but have a lighter colored surface layer.

Most areas of this soil are used as cropland. Grain sorghum, peanuts, soybeans, and wheat are the main crops. Growing soil-improving crops and leaving plant residue on or near the soil surface improve soil tilth. Applications of fertilizer increase yields.

Some areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, indiangrass, switchgrass, introduced bluestems, and lovegrass are suitable improved pasture species. Pastures can be overseeded with arrowleaf, ball, hop, and white clovers as well as singletary peas, lespedeza, and vetch in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and proper fertilization are management concerns.

Only a few areas of this soil are used as native pasture. The native vegetation includes cottonwood, sweetgum, ash, sycamore, elm, pecan, and oak trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. Wetness and the potential for shrinking and swelling with changes in moisture are limitations that must be considered when building sites are selected. Low strength is a limitation when streets and roads are constructed. Moderately slow permeability and wetness can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Waskom soil is in capability subclass IIw. The woodland ordination symbol is 9W.

WhB—Whakana very fine sandy loam, 1 to 3 percent slopes

This very deep, very gently sloping soil is on the third and fourth terrace levels of the Red River. Areas are irregular in shape and range in size from 30 to 600 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 14 inches, brown very fine sandy loam

Subsoil:
14 to 32 inches, red sandy clay loam
32 to 80 inches, red sandy clay loam with vertical streaks of white sand

Important Soil Properties

Available water capacity: moderate
Permeability: moderate
Drainage class: well drained
Runoff: very low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid to neutral in the surface layer, very strongly acid to slightly acid in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Porum soils. These soils have a sandy clay loam subsoil.

Most areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, indiangrass, switchgrass, and weeping lovegrass are suitable improved pasture species. Pastures can be overseeded with legumes, such as arrowleaf, ball, hop, and white clovers as well as lespedeza, singletary peas, or vetch, in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and proper fertilization are management concerns.

Some areas of this soil are used as cropland. Grain

sorghum, soybeans, peanuts, and wheat are the main crops. Truck crops or peaches are grown in a few areas. Growing cover crops and soil-improving crops and leaving plant residue on or near the soil surface help to control erosion and improve soil tilth. Applications of fertilizer increase crop yields.

A few areas of this soil are used as native pasture. The native vegetation consists of mixed hardwood trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Several areas of this soil have been planted to loblolly pine.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Whakana soil is in capability subclass IIe. The woodland ordination symbol is 8A.

WhC—Whakana very fine sandy loam, 3 to 5 percent slopes

This very deep, gently sloping soil is on the third and fourth terrace levels of the Red River. The surface is convex. Areas range from 15 to 800 acres in size.

Typical Profile

Surface layer:
0 to 10 inches, brown very fine sandy loam

Subsoil:
10 to 24 inches, yellowish red sandy clay loam
24 to 40 inches, red sandy clay loam with brown mottles
40 to 65 inches, red sandy clay loam with vertical streaks of light gray sand

Important Soil Properties

Available water capacity: moderate
Permeability: moderate
Drainage class: well drained
Runoff: low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid to neutral in the surface layer, very strongly acid to slightly acid in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Hazard of water erosion: moderate
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Porum soils. These soils have a sandy clay loam subsoil.

Most areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, fescue, indiangrass, switchgrass, and weeping lovegrass are suitable improved pasture species. Pastures can be overseeded with legumes, such as arrowleaf, ball, hop, and white clovers as well as lespedeza, singletary peas, or vetch, in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Controlled grazing, weed control, and proper fertilization are management concerns.

Some areas are used as cropland. Grain sorghum, soybeans, peanuts, and wheat are the main crops. Truck crops or peaches are grown in a few areas. Growing cover crops and soil-improving crops and leaving plant residue on or near the soil surface help to control erosion and improve soil tilth. Applications of fertilizer increase crop yields. Terraces are needed to control erosion.

A few areas of this soil are used as native pasture. The native vegetation consists of mixed hardwood trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Several areas of this soil have been planted to loblolly pine.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. Moderate permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Whakana soil is in capability subclass IIIe. The woodland ordination symbol is 8A.

WhD—Whakana very fine sandy loam, 5 to 12 percent slopes

This very deep, strongly sloping soil is on slopes between the second and fourth terrace levels of the Red River. Areas are oblong, follow the contour of the

slope, and range in size from 20 to 1,900 acres. The surface is convex.

Typical Profile

Surface layer:
0 to 10 inches, brown very fine sandy loam

Subsoil:
10 to 22 inches, yellowish red sandy clay loam
22 to 45 inches, red sandy clay loam
45 to 80 inches, red sandy clay loam with streaks of white loamy sand

Important Soil Properties

Available water capacity: moderate
Permeability: moderate
Drainage class: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately acid to neutral in the surface layer, very strongly acid to slightly acid in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Porum soils. These soils have a sandy clay loam subsoil. Also included are a few gullied areas.

Most areas of this soil are used as native pasture. The native vegetation consists of mixed hardwood trees with an understory of grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Some areas of this soil are used as improved pasture. Coastal bermudagrass, common bermudagrass, bahiagrass, indiangrass, introduced bluestems, switchgrass, and weeping lovegrass are suitable improved pasture species. Legumes, such as arrowleaf, ball, crimson, and hop clovers as well as lespedeza, singletary peas, and vetch, produce additional forage and add nitrogen to the soil. Management concerns include controlled grazing, weed control, and proper fertilization.

Because of the severe hazard of water erosion, only a few areas of this soil are used as cropland.

This soil has several limitations that affect urban uses. The slope and the potential for shrinking and swelling of the subsoil with changes in moisture are limitations that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. Moderate permeability and the slope can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Whakana soil is in capability subclass IVe. The woodland ordination symbol is 8A.

Ws—Whitesboro loam, occasionally flooded

This very deep, nearly level soil is on flood plains. It is subject to brief flooding about one time in 10 years. Areas are dissected by meandering channels 3 to 6 feet deep and 10 to 20 feet wide. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 18 inches, very dark grayish brown loam
18 to 36 inches, dark brown clay loam

Subsoil:
36 to 80 inches, brown clay loam

Important Soil Properties

Available water capacity: high
Permeability: moderate
Drainage class: moderately well drained
Runoff: negligible
Water table: none within a depth of 6 feet; however, the soil may be saturated between depths of 2 and 4 feet for short periods after heavy rainfall.
Root zone: very deep
Soil reaction: slightly acid to slightly alkaline
Shrink-swell potential: moderate
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of similar but lighter colored soils.

Most areas of this soil are used as improved pasture. Mixtures of bermudagrass and arrowleaf clover are grown in most of these areas. Other suitable improved pasture species are fescue, bahiagrass, Kleingrass, and switchgrass. Legumes, such as ball, hop, and white clovers as well as singletary peas, lespedeza, and vetch, can be grown with these grasses in order to produce additional forage and add nitrogen to the soil. Proper grazing management helps to maintain plant vigor, the ground cover, and soil tilth.

Some areas of this soil are used as rangeland. The climax vegetation consists of pecan, hackberry, cottonwood, and elm trees with an understory of tall and mid grasses. Proper management of grazing

heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Whitesboro soil is in capability subclass IIw and in the Loamy Bottomland range site. The woodland ordination symbol is 5W.

Wt—Whitesboro loam, frequently flooded

This very deep, nearly level soil is on narrow flood plains. It is flooded more than once per year for brief periods during the spring and fall months. Areas are dissected by meandering channels 3 to 6 feet deep and 10 to 25 feet wide. Slopes are 0 to 1 percent.

Typical Profile

Surface layer:
0 to 8 inches, very dark grayish brown loam
8 to 36 inches, dark brown clay loam
36 to 60 inches, very dark grayish brown clay loam with yellowish red mottles

Important Soil Properties

Available water capacity: high
Permeability: moderate
Drainage class: moderately well drained
Runoff: negligible
Water table: none within a depth of 6 feet; however, the soil may be saturated between depths of 2 and 4 feet for short periods after heavy rainfall.
Root zone: very deep
Soil reaction: slightly acid to slightly alkaline
Shrink-swell potential: moderate
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of similar but lighter colored soils.

Most areas of this soil are used as rangeland. The climax vegetation consists of pecan, hackberry, cottonwood, and elm trees with an understory of mid and tall grasses. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

Because of the hazard of flooding, this soil is poorly suited to cropland and only a few areas are used as improved pasture.

This soil is unsuitable for urban uses because of the hazard of flooding.

The Whitesboro soil is in capability subclass Vw and in the Loamy Bottomland range site. The woodland ordination symbol is 5W.

WwD2—Whitewright-Howe complex, 5 to 12 percent slopes, eroded

These shallow and moderately deep soils are on strongly sloping, convex side slopes. Many areas have active gullies that have exposed chalk bedrock. Sheet erosion has removed 50 percent of the surface soil from the areas between the gullies. Areas range from 10 to 1,500 acres in size.

This unit is about 60 percent Whitewright soil, 20 percent Howe soil, and 20 percent other soils. The shallow Whitewright soil generally is in the more sloping areas on the upper part of the landscape. The moderately deep Howe soil is in the less sloping areas, generally on the lower part of the landscape. The soils of this unit are too intricately mixed to be mapped separately at the scale used.

Typical Profile of the Whitewright Soil

Surface layer:
0 to 7 inches, dark grayish brown silty clay loam

Subsoil:
7 to 17 inches, dark brown silty clay loam

Substratum:
17 to 30 inches, gray chalk

Important Properties of the Whitewright Soil

Available water capacity: very low
Permeability: moderate
Drainage class: well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: severe
Hazard of wind erosion: slight

Typical Profile of the Howe Soil

Surface layer:
0 to 7 inches, dark brown silty clay loam

Subsoil:
7 to 20 inches, brown silty clay loam
20 to 32 inches, grayish brown silty clay loam

Substratum:
32 to 40 inches, white chalk

Important Properties of the Howe Soil

Available water capacity: low
Permeability: moderate
Drainage class: well drained

Runoff: high
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: moderately alkaline
Shrink-swell potential: moderate
Hazard of water erosion: severe
Hazard of wind erosion: slight

Included with these soils in mapping are small areas of Austin soils. These included soils are in gently sloping areas.

Most areas of this complex are used as rangeland. The climax vegetation consists of a mid grass prairie with scattered elm, hackberry, bois d'arc, and small oak trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This complex is poorly suited to cropland because of the severe hazard of water erosion.

This complex is poorly suited to improved pasture. The depth to bedrock limits forage production.

These soils have several limitations that affect urban uses. The depth to bedrock, the slope, and the potential for shrinking and swelling with changes in moisture are limitations that must be considered when the foundations of buildings are designed. Low strength is a limitation when streets and roads are constructed. The depth to bedrock can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel.

The Whitewright and Howe soils are in capability subclass VIe and the Chalky Ridge range site.

WzA—Wilson silt loam, 0 to 1 percent slopes

This very deep, nearly level soil is on terraces associated with uplands. The surface is plane or slightly concave. Areas range from about 40 to 1,700 acres in size.

Typical Profile

Surface layer:
0 to 8 inches, very dark gray silt loam

Subsoil:
8 to 24 inches, very dark gray silty clay
24 to 40 inches, dark gray silty clay loam
40 to 55 inches, gray silty clay loam with brownish yellow mottles

Substratum:
55 to 80 inches, light gray clay with brownish yellow mottles

Important Soil Properties

Available water capacity: high
Permeability: very slow
Drainage class: moderately well
Runoff: negligible
Water table: none within a depth of 6 feet; however, soil is saturated in the surface layer for short periods in most years.
Root zone: very deep, but dense subsoil may restrict root growth.
Soil reaction: slightly acid or neutral in the surface layer, slightly acid to moderately alkaline in the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Hazard of water erosion: slight
Hazard of wind erosion: slight

Included with this soil in mapping are small areas of Bonham, Crockett, and Normangee soils. Bonham soils are in slightly convex, gently sloping areas. Crockett and Normangee soils are on gently sloping ridges. Also included are small areas of Wilson soils with slopes up to 1.5 percent.

This soil is used mainly as cropland or improved pasture. Corn, grain sorghum, soybeans, and wheat are the main crops. The dense subsoil restricts root growth and thus limits the production of warm-season crops. Growing soil-improving crops and cover crops and leaving plant residue on or near the soil surface improve soil tilth. Applications of fertilizer increase yields.

Bahiagrass, coastal bermudagrass, common bermudagrass, introduced bluestems, indiangrass, switchgrass, and weeping lovegrass are suitable improved pasture species. Legumes, such as arrowleaf, ball, crimson, hop, and white clovers as well as singletary peas and vetch, can be grown in improved pastures in order to produce additional forage and add nitrogen to the soil. Applications of fertilizer improve the quality and increase the quantity of the forage. Good management includes controlled grazing, weed control, and proper fertilization.

Some areas of this soil are used as rangeland. The climax vegetation consists of a tall and mid grass prairie with scattered elm, mesquite, oak, and bois d'arc trees. Proper management of grazing heights and grazing periods is needed to maintain plant vigor and the ground cover.

This soil has several limitations that affect urban uses. The potential for shrinking and swelling of the subsoil with changes in moisture is a limitation that must be considered when the foundations of buildings are designed. Low strength and the potential for

shrinking and swelling of the subsoil with changes in moisture are limitations when streets and roads are constructed. Very slow permeability can interfere with the proper functioning of septic tank absorption fields. Corrosivity is a limitation affecting the use of unprotected steel and untreated concrete.

The Wilson soil is in capability subclass IIIw and in the Claypan Prairie range site.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 5 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

A recent trend in land use in some parts of the survey area has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with nature.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The system of land capability classification used by the Natural Resources Conservation Service is explained. The estimated yields of the main crops and hay and pasture plants are listed for each soil in table 6.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading “Detailed Soil Map Units.” Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

About 392,480 acres in the survey area was used for crops and pasture in 1989. Of this total, 161,870 acres was used for improved pasture; 33,150 acres for row crops of corn, cotton, grain sorghum, peanuts, and soybeans; and 196,460 acres for close-growing crops, mainly wheat, oats, forage sorghum, and alfalfa. About 3,500 acres was irrigated and was used mainly for peanuts and soybeans.

The potential of the soils in Fannin County for increased production of food is good. Several thousand acres of potentially good cropland is currently used as rangeland or pasture. In addition to the reserve productive capacity represented by this acreage, food production could be increased considerably by applying the latest crop production technology to all of the cropland in the county. This soil survey can greatly facilitate the application of such technology.

The acreage of the agricultural land in Fannin County is slowly decreasing as more land is used for urban and commercial development. In 1989, about 10,550 acres in Fannin County was urban land or built-up land.

Water erosion is the major concern on nearly all the cropland with slopes of more than 1.5 percent.

Loss of the surface layer through erosion is damaging. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Soils with a thin, loamy surface layer and a clayey subsoil are especially damaged when the surface layer is lost. Many acres of the naturally droughty Crockett, Crosstell, and Normangee soils have been severely damaged in this way. Erosion also damages soils with a layer of bedrock that limits the depth of the root zone. Shallow and moderately deep

soils that are underlain by bedrock include Austin, Howe, Stephen, and Whitewright soils.

Soil erosion on farmland results in sedimentation. Control of erosion minimizes sedimentation and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Erosion-control practices provide a protective surface cover, help to control runoff and wind erosion, and increase the rate of water infiltration. A cropping system that keeps a vegetative cover on the soil for extended periods holds soil losses to amounts that maintain the productive capacity. On livestock farms, which require pasture and hay, perennial grasses and legumes in the cropping or pasture system help to control erosion in sloping areas, provide nitrogen, and improve the physical condition of the soil.

Tillage systems that leave crop residue on the surface help to control runoff and erosion. Soil compaction is minimized if fewer trips are made over the soil. Crop residue management and less soil disturbance result in less evaporation of moisture from the soil. These tillage systems also conserve energy.

Terraces and diversions reduce the length of the slope, slow runoff, and help to control erosion. They are most practical on deep, well drained and moderately well drained soils with regular slopes. Deep and moderately deep soils are suitable for terraces if grassed waterways and stable outlets can be established. Other soils are not so suitable for terraces and diversions because of the slope, a sandy surface layer, or bedrock at a depth of less than 20 inches.

Information on erosion-control practices for each kind of soil can be obtained at local offices of the Natural Resources Conservation Service.

Drainage is not a problem on most soils in Fannin County. On the nearly level, very slowly permeable soils, wetness can damage crops or pasture plants in some years.

Fertility is naturally high in most soils on flood plains, such as Belk, Frioton, Hopco, Norwood, Redlake, Severn, and Tinn soils. Many of the moderately alkaline soils on uplands, such as Austin, Bonham, Dalco, Fairlie, Houston Black, and Leson soils, are also high in natural fertility. The loamy and sandy soils on uplands, such as Konawa, Larton, Porum, and Whakana soils, are low in natural fertility. Most of the sandy and loamy soils in the county require an application of a complete fertilizer; however, most soils south of U.S. Highway 82 are naturally high in potassium. Soils that have a loamy fine sand surface layer need a split application of a complete fertilizer to keep fertility in balance and to reduce loss of nutrients by leaching. On all soils, the amount and type of fertilizer should be based on the results of soil tests, the needs of the crops, the expected levels of yields, the previous land use or cropping sequence, and the amount of available soil moisture. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer to be applied.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water. Soils that have good tilth are granular and porous. High residue-producing crops, such as wheat and grain sorghum, tend to increase the content of organic matter and improve soil tilth.

Soils that have a light colored surface layer of fine sandy loam or very fine sandy loam have a low content of organic matter. The structure of these soils generally is weak. After periods of intense rainfall, a crust forms on the surface. This crust reduces the rate of water infiltration and increases the runoff rate. Regular additions of crop residue, manure, and other organic material improve soil structure and minimize crusting. Dark colored soils have a clayey surface layer and have moderate amounts of organic matter. Generally, such soils have moderate structure. They are difficult to work because they are sticky when wet and extremely hard when dry. Good seedbeds are difficult to prepare. If plowed when wet, these soils tend to be very cloddy after drying. Plowing during wet periods also causes dense plowpans to develop, and these impede the downward movement of air and moisture and the growth of plant roots. Fall plowing generally results in good tilth for spring planting.

Field crops suited to the soils and climate of the survey area include some that are not commonly grown. Corn, grain sorghum, soybeans, and peanuts are the principal row crops. Sunflowers and similar crops can be grown if economic conditions are favorable.

Wheat, oats, and forage sorghum are the most common close-growing crops. Rye, barley, and alfalfa also are grown. Grass and legume seed can be produced from Kleingrass, fescue, switchgrass, yellow bluestems, arrowleaf clover, and vetch.

Specialty crops have been grown commercially in the county, but few are now grown. These crops include black-eyed peas, okra, onions, tomatoes, turnips, sweet potatoes, and squash.

Deep soils that have natural drainage and that warm up early in the spring are especially well suited to many vegetables and small fruits. In this survey area, these soils are the Bastrop, Karma, Porum, Freestone, and Whakana soils with slopes of less than 3 percent. Crops generally can be planted and harvested earlier on these soils than on other soils in

the survey area. In many years, timely irrigation doubles the yields of most horticultural crops.

Most of the deep, well drained, loamy and sandy soils in the survey area are suitable for orchards, vineyards, and nursery plants. Soils in low positions, where frost is frequent or drainage is poor, are poorly suited to early vegetables, small fruits, and orchard crops.

The latest information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and of the Natural Resources Conservation Service.

Pasture is important in Fannin County because the raising of livestock is the main farm enterprise (fig. 15). For the past several years, the trend has been to convert land from other uses to pasture and hay. Land used for pasture and hay generally is planted to introduced grasses that respond to good management. These grasses are used mainly to provide year-round grazing in combination with native range and supplemental pastures. Erosion is not a problem where pasture grasses are properly managed.

Among the most important grasses are improved bermudagrass, common bermudagrass, improved varieties of Kleingrass, weeping lovegrass, Johnsongrass, indiangrass, switchgrass, plains bluestem, and Caucasian bluestem.

Coastal bermudagrass, switchgrass, and Kleingrass are better suited to deep soils on bottom land than to other soils in the county. These grasses, however, will grow on most of the soils in the county if a good seedbed can be prepared. If such soils as Crockett, Crosstell, and Ferris soils are eroded, management problems with improved bermudagrasses, switchgrass, and Kleingrass develop because of the droughty nature of these soils. These and other droughty soils are better suited to drought-resistant grasses, such as plains bluestem and Caucasian bluestem.

Weeping lovegrass is widely suited to these soils and provides good yields of forage on sandy and

Figure 15.—Raising livestock is important to the economy of Fannin County. This pasture and stock pond are in an area of Ferris clay, 5 to 12 percent slopes, eroded.

loamy soils on uplands, such as Konawa, Porum, Larton, and Whakana soils.

Forage legumes overseeded into permanent pastures provide nitrogen fixation for pastures, extend the grazing season, and improve pasture quality. The two most important legumes overseeded into permanent pastures are arrowleaf clover and hairy vetch. Arrowleaf clover is better suited to overseeding into loamy or sandy soils. Hairy vetch is better suited to overseeding into soils that have a clay loam or clay surface layer.

Good pasture management practices include fertilization, rotation grazing to maintain a proper grazing height of forage, weed and brush management, and an adequate water supply. Good management practices for hay are applying fertilizer and cutting the forage at the correct height and at the proper stage of growth.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals I through VI. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w* or *s* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section “Detailed Soil Map Units” and in table 6.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared

with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Rangeland

Joe Moore, conservation agronomist, Natural Resources Conservation Service, helped prepare this section.

About 6 percent of Fannin County, or 35,000 acres, is used as rangeland. More than 17,000 acres is in the Caddo National Grasslands. More than 44 percent of the agricultural income in the county is derived from the sale of livestock, principally cattle. Cow-calf operations are dominant in the county. The average size of the ranches is 250 to 300 acres.

Most of the rangeland is in the southern part of the county. The deep, dark Blackland soils and the lighter colored soils underlain by chalk produce excellent tall grass prairie. Many of the soils in the county, especially the deeper Blackland soils, were farmed at one time but have since been converted back to rangeland.

In areas of rangeland the native vegetation consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. The vegetation is generally suitable for grazing and browsing by livestock and wildlife. The composition and production of the plant community are strongly influenced by the soils, climate, topography, overstory canopy, and grazing management. Rangeland is not regularly treated with intensive cultural practices, such as fertilization and tillage.

Range Sites and Range Condition

Soils vary in their capability to produce grasses and other plants suitable for grazing. Soils that produce about the same kinds and amounts of forage are grouped into a range site.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community. This community differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. This natural plant community is also referred to as the climax plant community or climax vegetation because it is the product of all the environmental factors responsible for its development.

Generally, the climax vegetation consists of the plants that were present when the area was first settled. If a site has at least 75 percent of the plants that characterize the climax vegetation, the plant community is relatively stable. It will reproduce itself so that plant composition will not change significantly as long as the environment remains unchanged. If the area is undisturbed and improved plants are not introduced, the most productive combination of forage plants on a range site is the climax vegetation.

Range sites are subject to many influences that modify or even temporarily destroy vegetation. Examples are drought, overgrazing, wildfires, and short-term tillage. If these conditions are not too severe, the plant community will recover and return to climax. However, severe deterioration of the range site may permanently alter the potential of the site.

Grazing can change the quality and quantity of forage on a range site by changing the composition of the plant community.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in relative amount as the more desirable decreasers are reduced in amount by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that are normally not included in the climax plant community because they cannot compete with the climax vegetation for moisture, nutrients, and light. They invade the site and grow along with increasers only after the amount of the climax vegetation has been reduced by continual heavy grazing. Most invader species have little grazing value.

Range management requires a knowledge of the kinds of soil and of the climax or potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the climax plant community on a particular range site. The more closely the existing community resembles the climax community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning relating to the present plant community in a given use.

Four range condition classes are used to show the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. A range site is in excellent condition if 76 to 100 percent of the present plant community is the same as the climax vegetation; in good condition if the percentage

is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing season.

Following years of prolonged overuse of range, seed sources of desirable vegetation will be eliminated. Under these conditions, the vegetation must be reestablished before management can be effective. The condition of the range can be improved by brush control, range seeding, fencing, water development, or other mechanical treatments that revitalize stands of native plants.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the climax plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, water conservation, and erosion control. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Good production of livestock and forage on rangeland is obtained primarily by managing the time of grazing and limiting the amount of forage removed. The green parts of plants manufacture food for growth and store part of it for use in regrowth and seed production. The management practices that permit this process to take place are described in the following paragraphs.

Proper grazing use.—The objective of this practice is to graze at an intensity that will maintain enough cover to protect the soil and maintain or improve the quantity of desirable vegetation.

Deferred grazing.—This is the deferment or restriction of grazing until the better forage plants have completed most of their seasonal growth or have made seed. It helps to keep the desirable plants healthy and vigorous and permits plants that have been depleted to recover. Deferred grazing improves the plant cover and reduces the hazard of erosion.

Fencing.—This practice excludes livestock from areas that should be protected from grazing, confines livestock to an area, subdivides grazing land to permit use of planned grazing systems, and protects new seedlings or plantings from grazing.

Prescribed burning.—Livestock operators and wildlife managers use this practice to periodically remove or reduce a dense cover of mature vegetation. When done properly and at the right time, this practice will stimulate new, succulent growth; help to restore climax plant species; and reduce infestations of noxious weeds and brush. However, desirable plants can be severely damaged or killed if the soil surface is too dry, allowing the fire to reach the plant crowns and roots. Burning more often than once every 3 years may harm the perennial grass vegetation. Prescribed burning is an effective management tool that can be substituted for chemical or mechanical treatments in many plant communities.

Planned grazing systems.—The objective of this practice is to rotate the grazing of livestock through two or more pastures in a planned sequence for a specified period of time. A planned grazing system may be relatively simple in design if it includes two pastures, or it may be more complex and management intensive if it includes one or two herds and many pastures. To be successful, the grazing system must be tailored to the conditions in each ranch unit and meet the needs of the plants and animals as well as the rancher.

Table 7 shows, for each soil that supports rangeland vegetation suitable for grazing, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in table 7 follows.

A *range site* is indicated for each soil map unit listed in table 7. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. Production includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as

exposure, amount of shade, recent rains, and unseasonable dry periods.

Woodland Management and Productivity

Johnny M. Patterson, forester, Natural Resources Conservation Service, assisted in writing this section.

Less than 0.5 percent of the acreage in Fannin County is used as commercial woodland. The wooded areas consist mainly of small, scattered loblolly pine plantations on upland soils. Some consist of mixed hardwood forests along major drainageways, on terraces along the Red River, and on flood plains along the North Sulphur River.

The lack of a local market for pine has hampered the timely harvest of most pine plantations. Most of the plantations have become overstocked and require thinning.

Soils vary in their ability to produce trees. Available water capacity and depth of the root zone have major effects on tree growth. Permeability, fertility, texture, drainage, and position on the landscape also influence tree growth.

This soil survey can be used by woodland owners or forest managers in planning ways to increase the productivity of forest land. Some soils respond better to applications of fertilizer than others, and some are more susceptible to erosion after roads are built and timber is harvested. Some soils require special reforestation efforts. For each map unit in the survey area suitable for timber production, table 8 includes information about productivity. Table 8 also rates the soils for a number of factors to be considered in management. *Slight, moderate,* and *severe* are used to indicate the degree of the major soil limitations to be considered in forest management.

Table 8 lists the *ordination symbol* for each soil. The first part of the ordination symbol, a number, indicates the potential productivity of a soil for the indicator species based on its site index. The larger the number, the greater the potential productivity.

The second part of the ordination symbol, a letter, indicates the major kind of soil limitation affecting use and management. The letter *W* indicates a soil in which excessive water, either seasonal or year-round, causes a significant limitation. The letter *T* indicates a soil that has, within the root zone, excessive alkalinity, acidity, sodium salts, or other toxic substances that limit or impede the development of desirable trees. The letter *C* indicates a soil that has a limitation because of the kind or amount of clay in the upper part of the profile. The letter *S* indicates a dry, sandy soil. The letter *A* indicates a soil having no significant limitations that affect forest use and management. If a soil has more than one limitation, the priority is as follows: W, T, C, and S.

Ratings of the *erosion hazard* indicate the probability that damage may occur if site preparation or harvesting activities expose the soil. The risk is *slight* if no particular preventive measures are needed under ordinary conditions; *moderate* if erosion-control measures are needed for particular silvicultural activities; and *severe* if special precautions are needed to control erosion for most silvicultural activities. Ratings of moderate or severe indicate the need for construction of higher standard roads, additional maintenance of roads, additional care in planning harvesting and reforestation activities, or the use of special equipment.

Ratings of *equipment limitation* indicate limits on the use of forest management equipment, year-round or seasonal, because of such soil characteristics as slope, wetness, and texture of the surface layer. As slope gradient and length increase, it becomes more difficult to use wheeled equipment. On the steeper slopes, tracked equipment may be needed. The rating is *slight* if equipment use is restricted by wetness for less than 1 month and if special equipment is not needed. The rating is *moderate* if slopes are so steep (15 to 25 percent) that wheeled equipment may not be operated safely across the slope, if wetness restricts equipment use from 1 to 3 months per year, if a sandy or clayey surface layer restricts the use of ground-based equipment, or if special equipment is needed to prevent or minimize compaction. The rating is *severe* if slopes are so steep (more than 25 percent) that wheeled equipment cannot be operated safely across the slope, if wetness restricts equipment use for more than 3 months per year, if the surface layer is loose sand that severely restricts the use of ground-based equipment, or if special equipment is needed to prevent or minimize compaction. Ratings of moderate or severe indicate a need to choose the best suited equipment and to carefully plan the timing of harvesting and other management activities.

Ratings of *seedling mortality* refer to the probability of the death of naturally occurring or properly planted seedlings of good stock in periods of normal rainfall, as influenced by kinds of soil or topographic features. Seedling mortality is caused primarily by too much water or too little water. The factors used in rating a soil for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, and rooting depth. The mortality rate generally is highest on soils that have a sandy or clayey surface layer. The risk is

slight if, after site preparation, expected mortality is less than 25 percent; *moderate* if expected mortality is between 25 and 50 percent; and *severe* if expected mortality exceeds 50 percent. Ratings of moderate or severe indicate that it may be necessary to increase the number of trees planted per acre or to make special site preparations, such as bedding, furrowing, installing a surface drainage system, and providing artificial shade for seedlings. Reinforcement planting is often needed if the risk is moderate or severe.

Ratings of *windthrow hazard* indicate the likelihood that trees will be uprooted by the wind. A restricted rooting depth is the main reason for windthrow. The rooting depth can be restricted by a high water table, a fragipan, or bedrock or by a combination of such factors as soil wetness, texture, structure, and depth. The risk is *slight* if strong winds cause trees to break but do not uproot them; *moderate* if strong winds cause an occasional tree to be blown over and many trees to break; and *severe* if moderate or strong winds commonly blow trees over. If the rooting depth is less than 20 inches, the soil has a severe rating. A severe rating indicates that care is needed in thinning or that the stand should not be thinned at all. Special equipment may be needed to prevent damage to shallow root systems in partial cutting operations. A plan for the periodic removal of windthrown trees and the maintenance of a road and trail system may be needed.

Ratings of *plant competition* indicate the likelihood of the growth or invasion of undesirable plants. Plant competition is more severe on the more productive soils, on poorly drained soils, and on soils having a restricted root zone that holds moisture. The risk is *slight* if competition from undesirable plants hinders adequate natural or artificial reforestation but does not necessitate intensive site preparation and maintenance. The risk is *moderate* if competition from undesirable plants hinders natural or artificial reforestation to the extent that intensive site preparation and maintenance are needed. The risk is *severe* if competition from undesirable plants prevents adequate natural or artificial reforestation unless the site is intensively prepared and maintained. A moderate or severe rating indicates the need for site preparation to control plant competition and ensure the development of an adequately stocked stand. Managers must plan site preparation measures to ensure reforestation without delays.

The *potential productivity* of *common trees* on a soil is expressed as a *site index* and a *volume* number. Common trees that have a commercial value are listed in the order of their observed general occurrence. Generally, only two or three tree species dominate. The first tree listed for each soil is the indicator species for that soil. An indicator species is a tree that is common in the area and that is generally the most productive on a given soil.

The *site index* is determined by taking height measurements and determining the age of dominant and codominant trees within stands of a given species. The index is the average height, in feet, that the trees attain in a specified number of years. This number is 50 years for nearly all trees, but it is 30 years for cottonwood. The site index applies to fully stocked, even-aged, unmanaged stands.

The *volume* is the yield likely to be produced by the most important trees, expressed in board feet (Doyle Rule) per acre per year. These annual yield figures apply to fully stocked, natural stands that do not have a history of any intermediate cutting management. Therefore, applying sound forestry management practices, such as scheduled thinnings, significantly increases the listed yields.

Trees to plant are those that are used for reforestation or, under suitable conditions, natural regeneration. They are adapted to the soils and can produce a commercial wood crop. The desired product, topographic position (such as a low, wet area), and personal preference are three factors among many that can influence the choice of trees for use in reforestation.

Woodland Understory Vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. If well managed, some woodland can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees.

The density of the canopy determines the amount of light that reaches the understory plants. Canopy cover is a major factor affecting the production of vegetation that is within reach of livestock and large game animals. Livestock management and good silvicultural practices, such as thinning of timber stands, removal of cull trees, and controlled burning, are necessary to maintain moderate to good production of understory vegetation. Without the proper management practices, the canopy cover increases drastically because of the growth of shrubs and hardwoods in the midstory. A site that has a closed canopy of 75 percent or more may not have sufficient carrying capacity for a profitable livestock operation. Use of the site by large game animals will be limited because sufficient browse plants are not available.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter.

In addition to proper woodland management, the following practices can help to achieve high levels of forage production.

Proper woodland grazing is grazing at an intensity that maintains or improves the quantity and quality of desirable plants. It is generally thought to be grazing of no more than half, by weight, of the annual growth of key forage plants in preferred grazing areas. Proper grazing increases the vigor and reproductive capacity of key forage plants, conserves soil and water, improves the condition of the vegetation, increases forage production, maintains natural beauty, and reduces the hazard of wildfire.

Deferred grazing consists of postponing grazing or resting the grazing land for a prescribed period. The rest period promotes the growth of natural vegetation by permitting the vigor of the forage to increase and by allowing desirable plants to seed. Deferred grazing provides feed reserves for fall and winter, improves the appearance of land by increasing the vegetative cover, and reduces the hazard of erosion.

Planned grazing systems are systems in which two or more grazing units are rested in a planned sequence throughout the year or during the growing season of key forage plants. These systems improve the production of desirable forage plants and trees.

Prescribed burning is the use of fire under controlled conditions. It can be used to control undesirable vegetation, increase production by removal of part of the organic layer, reduce the hazard of wildfire, and remove old, unpalatable forage plants.

Table 9 shows, for each soil suitable for woodland, the potential for producing understory vegetation. The total production of understory vegetation includes the herbaceous plants and the leaves, twigs, and fruit of woody plants up to a height of 4.5 feet. It is expressed in pounds per acre of air-dry vegetation in favorable, normal, and unfavorable years. In a favorable year, soil moisture is above average during the optimum part of the growing season; in a normal year, soil moisture is average; and in an unfavorable year, it is below average.

Table 9 also lists the common names of the characteristic vegetation on each soil and the *composition*, by percentage of air-dry weight, of each kind of plant. The table shows the kind and percentage of understory plants expected under a canopy density that is most nearly typical of woodland in which the production of wood crops is highest.

Recreation

Ed M. Schwille, biologist, Natural Resources Conservation Service, and David Sierra, biologist, Texas Parks and Wildlife Department, helped prepare this section.

Fannin County is on the extreme western edge of the Piney woods. Most recreational activities are noncommercial; however, two shooting resorts are located north of Honey Grove. Facilities for such activities as photography, bird-watching, picnicking, camping, boating, hunting, fishing, and hiking are available on the Caddo National Grasslands and at Bonham State Park.

Lake Bonham, the largest lake in the county, and Lake Fannin, Coffee Mill Lake, Lake Davy Crockett, and Bonham State Park Lake are public impoundments available for water-related activities. Several other smaller impoundments are managed for private use.

Bonham State Park, operated by the Texas Parks and Wildlife Department, Parks Division, is southeast of Bonham and provides excellent recreational facilities. The Caddo National Grasslands, made up of approximately 17,796 acres, is in the southern, northern, and northeastern parts of the county. It is owned by the USDA, Forest Service, and is currently managed by the Texas Parks and Wildlife Department.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils that are subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special

design, intensive maintenance, limited use, or a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Ed M. Schwille, biologist, Natural Resources Conservation Service, and David Sierra, biologist, Texas Parks and Wildlife Department, helped prepare this section.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, and oats.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and

soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, and ragweed.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, sweetgum, hawthorn, dogwood, hickory, and blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine and cedar.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, meadowlark, mourning doves, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous and/or coniferous plants and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, nutria, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, meadowlark, and jackrabbit.

Fannin County has valuable fish and wildlife resources. Habitat for wildlife is throughout the county. Streams and large and small impoundments throughout the county provide plentiful habitat for fish.

Many of the soils in the county are suitable for impounding water, whereas others are not suitable because of excessive seepage. Ponds, small lakes, and large impoundments are stocked with and managed for largemouth bass, channel catfish, bluegill, redear sunfish, and crappie. Other species in the streams and public impoundments include green sunfish, carp, freshwater drum, flathead catfish, bullhead catfish, gar, buffalo, white bass, gizzard shad, and various other sunfish and minnows. Many of these species find their way into many of the unmanaged ponds and lakes. Small ponds, both new and renovated, are stocked with channel catfish and fathead minnows to provide a food source for the pond owners. Some of the larger lakes are managed for trophy bass production.

Bois d’Arc Creek is the major stream in the county. It extends from the southwest side of the county to the northeast corner, where it joins the Red River. Sandy, Spoonamore, and Coffee Mill Creeks drain into Bois d’Arc Creek. The Red River forms the northern boundary of the county. The North Sulphur, Middle Sulphur, and South Sulphur Rivers head in the southern part of the county. Lake Bonham is the largest public impoundment in the county. Other impoundments are Coffee Mill Lake, Lake Davy Crockett, Bonham State Park Lake, Club Lake, Lake Quail Haven, Thornton Lake, areas of water resulting from 18 floodwater-retarding structures, and several other smaller impoundments. Numerous ponds $^{1}/_{2}$ acre to 3 acres in size are in areas of suitable soils throughout the county.

Water quality in the ponds and lakes ranges from alkaline on the south and west sides of the county to moderately acid on the north and northeast sides. The acid waters are treated with agricultural lime at rates ranging from 1 to 3 tons per surface acre to improve water quality and production. Aquatic weeds pose some problems in clear waters.

The county has some small aquaculture operations. These are channel catfish operations selling fingerling, stocker, and food fish. The county has very few bait fish. Expansion of aquaculture will depend upon an

adequate water supply, improvement of water quality, and marketing. Fish are available in nearby counties for stocking in ponds and small impoundments.

The major game species of wildlife in the county include bobwhite quail, mourning dove, waterfowl, fox squirrel, and some white-tailed deer. Some wild turkeys inhabit the county, but their numbers are low. Raccoon, striped skunk, armadillo, opossum, cottontail rabbit, jackrabbit, numerous small rodents, and songbirds also inhabit the county. The most common predators are coyote, fox, and bobcat. Beaver, nutria, and mink inhabit aquatic habitats.

The most common reptiles and amphibians in the county are cottonmouth, copperhead, bull, and water snakes, green bullfrogs, cricket frogs, snapping turtles, and terrapin. Alligators are occasionally sighted.

Wood ducks nest and roost in creeks and shallow impoundments. During the migration period, waterfowl, such as northern mallard, teal, pintail, widgeon, gadwall, ring-necked ducks, and canvasback ducks, use the existing water areas for resting, feeding, and roosting. Coot and cormorant are on the larger impoundments. Great blue heron, smaller herons, cattle egrets, and other shorebirds are evident. White pelicans are evident during migration. Snow geese and Canada geese are common migrants through the county.

Many songbirds, raptors, vultures, and shorebirds migrate through and live in the county. Occasionally, bald eagles and ospreys are observed around the larger impoundments.

Fannin County is in the Post Oak Savannah and Blackland Prairies Vegetational Areas in Texas (Gould, 1962). “The Vegetation Types of Texas” (McMahan et al., 1984) identifies the vegetation types in Fannin County as Post Oak Woods, Forest and Grassland Mosaic, Post Oak Woods/Forest, Water Oak-Elm-Hackberry Forest, Crops, and Other Native and/or Introduced Grasses.

Crops are the dominant vegetation type. Cultivated crops can provide food and cover for wildlife, especially when crop residue is retained on the surface longer than 3 months. Small grain, grain sorghum, corn, and peanuts are the main seed-producing crops. Johnsongrass, common sunflower, Illinois bundleflower, western ragweed, elm, hackberry, pecan, bumelia, greenbriar, blackberry, threeawn, dropseed, and common bermudagrass are the most common associated plants. Quail, mourning doves, and numerous songbirds utilize this vegetation type. Crops are grown mainly in areas of the Fairlie-Dalco, Houston Black-Leson, Whitewright-Howe, Ferris, and Normangee-Wilson-Bonham general soil map units. These areas are dominant in the southern half of the county.

The Post Oak Woods, Forest and Grassland Mosaic vegetation type (commonly known as Post Oak Savannah) is on the loamy, strongly acid to slightly acid soils on terraces in the northern part of the county. The habitat has an association of plants that includes blackjack oak, shumard oak, eastern redcedar, mesquite, cedar elm, hackberry, yaupon, American beautyberry, hawthorn, dewberry, little bluestem, beaked panicum, prairie senna, and tickclover. Arrowleaf clover and vetch have been overseeded on many improved pastures that have been planted to bahiagrass or coastal bermudagrass. White-tailed deer, quail, mourning doves, fox squirrel, gray squirrel, and waterfowl are the game species inhabiting areas of this vegetation type. The Whakana-Porum-Freestone, Karma-Derly, Ivanhoe, and Severn-Belk-Redlake general soil map units are dominant in these areas.

Other Native and/or Introduced Grasses are throughout the central part of the county. Mixed native or introduced grasses and forbs on grasslands are a result of the clearing of woody vegetation. Bahiagrass, coastal bermudagrass, and fescue overseeded with arrowleaf clover and vetch are grown on improved pastures. Other species include little bluestem, indiangrass, threeawns, dropseeds, Johnsongrass, western ragweed, prairie senna, Illinois bundleflower, and tickclover. Quail, mourning dove, fox squirrel, and waterfowl are the main game inhabitants in areas of this vegetation type. The Normangee-Wilson-Bonham, Crockett, and Tinn general soil map units are dominant in these areas.

A very limited area of the Water Oak-Elm-Hackberry Forest vegetation type is northeast of Bonham. Associated plants are willow oak, red oak, cottonwood, pecan, bois d’arc, dallisgrass, wildrye, Johnsongrass, giant ragweed, dog fennel, and sedges. Squirrel and waterfowl are the primary wildlife game species in the area. The Tinn general soil map unit is dominant in this area.

Most habitat for desirable game species is created or managed by establishing, maintaining, or manipulating suitable vegetation. The application of management practices must be based on the habitat needs of the wildlife to be managed. Arbitrarily applied, many of these practices could be detrimental rather than beneficial. Managing for game species generally improves the habitat for many nongame species. Trained professionals from the Soil and Water Conservation District, the Texas Parks and Wildlife Department, or the Texas Agricultural Extension

Service should be contacted when this management is planned

Wetlands are on flood plains along the Red River and Bois d’Arc Creek, in areas of the Water Oak-Elm-Hackberry vegetation type, and adjacent to water bodies. The bottom land and open water provide winter habitat for waterfowl species, including wood ducks, mallards, teal, and pintail. The burrowing and damming activities of the beavers and nutria throughout the county can cause a variety of agricultural problems.

Some endangered or threatened species may migrate through Fannin County, but they are not permanent inhabitants. The Arctic peregrine falcon and southern bald eagle migrate through the county each fall and spring. Sometimes, the bald eagle can be observed around Lake Bonham or in the area of the Red River. Occasionally, an American alligator is observed. Alligators were recently removed from the threatened species list, but they are still on the watch list of the Texas Organization for Endangered Species. The unvegetated alluvial islands or sandbars in the Red River provide habitat for the interior least tern.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the “Soil Properties” section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations. Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special

feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly

level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained off site, transported to the landfill, and spread over the waste.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of

sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent; or they are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. The underlying material is not rated and should be evaluated during an onsite investigation. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings

apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading “Soil Series and Their Morphology.”

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. “Loam,” for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, “gravelly.” Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1998) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1998).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates

determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^1/_3$-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture

content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, 6 to 9 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep and very deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep to very deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at

selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Texas Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 422 (ASTM), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); Specific gravity (particle density)—T100 (AASHTO), D 653 (ASTM); and Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1999). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustalf (*Ust*, meaning burnt, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Paleustalfs (*Pale*, meaning excessive development, plus *ustalf*, the suborder of the Alfisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Udertic Paleustalfs, an intergrade to the Udert suborder.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, smectitic, thermic Udertic Paleustalfs.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. An example is the Crockett series, which is a fine, smectitic, thermic Udertic Paleustalf.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the “Soil Survey Manual” (Soil Survey Division Staff, 1993). Many of the technical terms used in the descriptions are defined in “Soil Taxonomy” (Soil Survey Staff, 1999). Unless otherwise indicated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section “Detailed Soil Map Units.”

Aubrey Series

The Aubrey series consists of moderately deep, well drained, slowly permeable, loamy soils on uplands. These soils formed in acid clay shales. Slopes range from 2 to 20 percent. Aubrey soils are clayey, mixed, thermic Typic Haplustults.

Typical pedon of Aubrey loam, 2 to 6 percent slopes; from the junction of Farm Road 898 and State Highway 121 north of Bonham, 3.4 miles west on

Farm Road 898, 0.4 mile south on county road, 100 feet east of road in wooded rangeland:

A—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; very hard, firm, nonsticky and nonplastic; many fine roots; common fine pores; slightly acid; abrupt smooth boundary.

Bt1—6 to 15 inches; dark reddish brown (5YR 3/4) clay, reddish brown (5YR 4/4) dry; moderate medium angular blocky structure; very hard, very firm, sticky and plastic; many fine roots; few fine pores; few clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt2—15 to 29 inches; prominently mottled dark red (2.5YR 3/6) and dark gray (10YR 4/1) clay, red (2.5YR 4/6) and gray (10YR 5/1) dry; moderate medium angular blocky structure; very hard, very firm, sticky and very plastic; common fine roots; few very fine pores; few clay films on faces of peds; strongly acid; gradual smooth boundary.

B/C—29 to 37 inches; dark red (2.5YR 3/6) clay, red (2.5YR 4/6) dry; moderate fine subangular blocky structure; about 40 to 50 percent dark gray (10YR 4/1) shale with clay texture and platy structure (C part); very hard, very firm, sticky and very plastic; strongly acid; clear smooth boundary.

Cr—37 to 45 inches; dark gray (10YR 4/1) shale with clay texture, gray (10YR 5/1) dry; few strata of strong brown (7.5YR 5/6) shale with clay texture; strongly acid.

The thickness of the solum ranges from 20 to 40 inches. The base saturation of the control section is slightly more than 35 percent.

The A horizon is 3 to 8 inches thick. It is very dark grayish brown, dark grayish brown, grayish brown, dark brown, or brown. The texture is loam or fine sandy loam. Reaction is moderately acid or slightly acid. A thin E horizon that is one or two units of value lighter in color than the A horizon is in some pedons.

The Bt horizon is red, light red, yellowish red, reddish brown, dark reddish brown, dark brown, dark red, reddish yellow, strong brown, or brown. Mottles of gray and dark gray range from few to many in the lower part of the horizon. Reaction is strongly acid or moderately acid.

Reaction in the B/C horizon is strongly acid or moderately acid.

The Cr layer is gray or dark gray. Some pedons are interbedded with thin strata of sandstone. Reaction ranges from extremely acid to strongly acid.

These soils are taxadjuncts to the Aubrey series because the base saturation is slightly higher than the range of the series. These soils also receive about 4 inches more rainfall annually than is typical for the series. The use, management, and behavior of these soils are not affected by these differences.

Austin Series

The Austin series consists of moderately deep, well drained, moderately slowly permeable, loamy soils on uplands. These soils formed in chalk interbedded with marl. Slopes range from 1 to 3 percent. Austin soils are fine-silty, carbonatic, thermic Udorthentic Haplustolls.

Typical pedon of Austin silty clay loam, 1 to 3 percent slopes; from the junction of Farm Road 814 and Texas Highway 121 in Trenton, 1.9 miles west on Farm Road 814 to county line, 1 mile north on county road, 0.2 mile east on county road, 200 feet south in cultivated field:

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; strong fine and very fine subangular blocky structure; compacted in the lower part; hard, friable, sticky and plastic; many fine roots; common fine pores; calcareous; moderately alkaline; clear smooth boundary.

A—7 to 15 inches; very dark brown (10YR 2/2) silty clay, very dark grayish brown (10YR 3/2) dry; strong fine subangular blocky structure; hard, friable, sticky and plastic; common fine roots; common fine pores; calcareous; moderately alkaline; gradual smooth boundary.

Bw1—15 to 26 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; strong fine and very fine subangular blocky structure; very hard, firm, sticky and plastic; common fine roots; few fine pores; common wormcasts; few fine chalk fragments; calcareous; moderately alkaline; gradual wavy boundary.

Bw2—26 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine pores; common concretions and soft masses of calcium carbonate; common soft chalk fragments; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—30 to 36 inches; white, platy chalk interbedded with marl.

The thickness of the solum ranges from 20 to 40 inches. The texture throughout the solum is clay, silty

clay, or silty clay loam, with a clay content ranging from about 35 to 50 percent. The control section has 40 to 65 percent calcium carbonate equivalent.

The combined thickness of the A horizons ranges from 8 to about 17 inches. These horizons are very dark grayish brown, dark grayish brown, or dark brown.

The Bw horizon is dark brown, brown, light brownish gray, grayish brown, dark grayish brown, or yellowish brown.

The Cr layer is platy chalk interbedded with marl. Some pedons have thick layers of massive chalk that is slightly weathered and platy in the upper few inches.

Bastrop Series

The Bastrop series consists of very deep, well drained, moderately permeable, loamy soils on terraces along the Red River. These soils formed in loamy alluvial sediments. Slopes range from 2 to 5 percent. Bastrop soils are fine-loamy, mixed, thermic Udic Paleustalfs.

Typical pedon of Bastrop loam, 2 to 5 percent slopes; from the junction of Farm Road 274 and Farm Road 1753 in Ravenna, 2.8 miles west on Farm Road 1753, 0.2 mile south on county road, 100 feet east of road in wooded rangeland:

A—0 to 11 inches; dark brown (7.5YR 4/4) loam, brown (7.5YR 5/4) dry; weak fine granular structure; hard, friable, nonsticky and nonplastic; many fine roots; many fine pores; slightly acid; gradual smooth boundary.

Bt1—11 to 29 inches; dark red (2.5YR 3/6) sandy clay loam, red (2.5YR 4/6) dry; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; discontinuous clay films on faces of peds; moderately acid; gradual smooth boundary.

Bt2—29 to 65 inches; red (2.5YR 4/6) sandy clay loam, red (2.5YR 5/6) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; discontinuous clay films on faces of peds; moderately acid; gradual smooth boundary.

BC—65 to 80 inches; yellowish red (5YR 5/8) loam, reddish yellow (5YR 6/8) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; discontinuous clay films on faces of peds; few clean sand grains on faces of peds; slightly acid.

The thickness of the solum ranges from 60 to more than 80 inches. The content of clay in the control section ranges from 20 to 35 percent. The solum has no siliceous pebbles or few siliceous pebbles throughout.

The A horizon is 4 to 14 inches thick and is dark brown, brown, yellowish brown, or reddish brown. Reaction ranges from moderately acid to neutral.

The Bt horizon is reddish brown, red, dark red, yellowish red, or reddish yellow. The texture is sandy clay loam or loam. Reaction ranges from moderately acid to neutral.

The BC horizon is red, yellowish red, or reddish yellow. The texture is sandy clay loam or loam. Reaction ranges from slightly acid to slightly alkaline. Some pedons have a few calcium carbonate concretions below a depth of 60 inches.

Belk Series

The Belk series consists of very deep, well drained, very slowly permeable, clayey soils on flood plains along the Red River. These soils formed in clayey sediments underlain by loamy sediments. Slopes are 0 to 1 percent. Belk soils are clayey over loamy, mixed, thermic Entic Hapluderts.

Typical pedon of Belk clay, rarely flooded; from the junction of Farm Road 100 and U.S. Highway 82 in Honey Grove, north on Farm Road 100 to Riverby Ranch headquarters, 1.5 miles north, 1.0 mile east, 0.1 mile south, and 0.9 mile east on private road, 200 feet south in cultivated field:

Ap—0 to 6 inches; dark reddish brown (5YR 3/4) clay, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; extremely hard, very firm, very sticky and very plastic; many fine roots; common fine pores; calcareous; moderately alkaline; clear smooth boundary.

Bss—6 to 27 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine roots; few fine pores; shiny surfaces on peds; common grooved slickensides; calcareous; moderately alkaline; abrupt wavy boundary.

2C—27 to 60 inches; yellowish red (5YR 4/6) silt loam, yellowish red (5YR 5/6) dry; few thin strata of reddish brown (5YR 5/4) very fine sandy loam and clay; massive with many distinct bedding planes;

slightly hard, very friable, nonsticky and nonplastic; calcareous; moderately alkaline.

The solum and underlying layers are calcareous and moderately alkaline throughout. The combined thickness of the A and Bss horizons ranges from 20 to 32 inches.

The A horizon is 3 to 9 inches thick. The color is dark reddish brown or reddish brown. Horizons with moist values of less than 3.5 are less than 7 inches thick.

The Bss horizon is dark reddish brown or reddish brown. The texture is silty clay or clay, with a clay content ranging from 40 to 60 percent.

The 2C horizon is reddish brown or yellowish red. The texture is silt loam or very fine sandy loam stratified with thin layers of clayey material. Some pedons have thin strata of loamy fine sand.

Benklin Series

The Benklin series consists of very deep, moderately well drained, moderately slowly permeable, loamy soils on terraces along major streams. These soils formed in loamy alluvial sediments. Slopes are 0 to 1 percent. Benklin soils are fine-silty, mixed, thermic Aquic Argiudolls.

Typical pedon of Benklin silt loam, 0 to 1 percent slope; from the junction of Texas Highway 34 and Farm Road 2990 in Ladonia, 1.6 miles north on Farm Road 2990, 200 feet west in cultivated field:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; hard, friable, nonsticky and nonplastic; many fine roots; common fine pores; neutral; clear smooth boundary.

Bt1—8 to 24 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium angular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; common wormcasts; few discontinuous clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—24 to 42 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; few fine yellowish brown (10YR 5/4) mottles; moderate fine and medium angular blocky structure; hard, friable, sticky and plastic; common fine roots; few fine pores; few wormcasts, few iron-manganese concretions; common discontinuous clay films on faces of peds; moderately alkaline; gradual smooth boundary.

Bt3—42 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; common fine distinct dark yellowish brown (10YR 4/6) mottles; moderate fine and medium angular blocky structure; hard, friable, sticky and plastic; few fine roots; few fine pores; few wormcasts; few iron-manganese concretions; discontinuous clay films on faces of peds; moderately alkaline; gradual smooth boundary.

Bt4—60 to 76 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; few fine faint yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; hard, friable, sticky and plastic; few fine roots; few fine pores; discontinuous clay films on faces of peds; few iron-manganese concretions; calcareous; moderately alkaline; gradual smooth boundary.

BC—76 to 80 inches; grayish brown (10YR 5/2) clay loam, light brownish gray (10YR 6/2) dry; common fine faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; hard, friable, sticky and plastic; few discontinuous clay films on faces of peds; few soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum is more than 60 inches thick. The mollic epipedon is 20 to 45 inches thick.

The A horizon is 5 to 18 inches thick and is very dark grayish brown, dark brown, or very dark brown. Reaction is slightly acid or neutral.

The Bt1 horizon is very dark grayish brown or very dark brown. The texture is loam, silty clay loam, or clay loam. Reaction is slightly acid or neutral.

The Bt2 and Bt3 horizons are very dark grayish brown, dark grayish brown, or dark brown. They have few or common yellowish brown mottles. The texture is loam, silty clay loam, or clay loam. Reaction ranges from slightly acid to moderately alkaline.

The Bt4 horizon is dark grayish brown or grayish brown. It has few or common yellowish brown mottles. The texture is loam, silty clay loam, or clay loam. Reaction is slightly alkaline or moderately alkaline.

The BC horizon is grayish brown or dark grayish brown. The texture is loam, silty clay loam, or clay loam. Reaction is slightly alkaline or moderately alkaline.

Birome Series

The Birome series consists of moderately deep, well drained, slowly permeable, loamy soils on uplands. These soils formed in iron-enriched sandy and clayey sediments. Slopes range from 2 to 12 percent. Birome soils are fine, mixed, thermic Ultic Paleustalfs.

Typical pedon of Birome fine sandy loam, 5 to 12 percent slopes; from the junction of Farm Road 1753 and Farm Road 1752, about 6 miles north of Savoy, 0.6 mile south on Farm Road 1752, 450 feet east of road in rangeland:

A—0 to 4 inches; dark brown (7.5YR 3/2) fine sandy loam, brown (7.5YR 4/2) dry; weak fine granular structure; hard, friable, nonsticky and nonplastic; many fine roots; common fine pores; slightly acid; clear smooth boundary.

Bt1—4 to 21 inches; reddish brown (5YR 4/4) sandy clay, reddish brown (5YR 5/4) dry; strong medium angular blocky structure; extremely hard, extremely firm, slightly sticky and plastic; many fine roots; few fine pores; common distinct clay films on faces of peds; 5 percent fine platy fragments of sandstone; strongly acid; gradual smooth boundary.

Bt2—21 to 30 inches; red (2.5YR 4/6) sandy clay, red (2.5YR 5/6) dry; few fine prominent dark grayish brown (10YR 4/2) mottles; strong medium angular blocky structure; extremely hard, extremely firm, slightly sticky and plastic; few fine roots; few fine pores; common distinct clay films on faces of peds; 5 percent fine platy fragments of sandstone; strongly acid; clear smooth boundary.

BC—30 to 36 inches; red (2.5YR 4/8) sandy clay, red (2.5YR 5/8) dry; common fine prominent light brownish gray (10YR 6/2) and brownish yellow (10YR 6/6) mottles; moderate medium angular blocky structure; extremely hard, extremely firm, slightly sticky and plastic; few fine roots; few fine pores; few faint clay films on faces of peds; 10 percent fine platy fragments of sandstone; strongly acid; clear wavy boundary.

Cr—36 to 46 inches; mottled red (2.5YR 4/8) and pale brown (10YR 6/3), weakly cemented sandstone interbedded with shale material; red (2.5YR 5/8) and very pale brown (10YR 7/3) dry; strongly acid.

The thickness of the solum ranges from 20 to 40 inches.

The A horizon is 3 to 10 inches thick and is brown, dark brown, dark grayish brown, grayish brown, light brownish gray, pale brown, very pale brown, light yellowish brown, yellowish brown, or light brown. Reaction ranges from moderately acid to neutral. An E horizon with color values one to three units higher than those in the A horizon is in some pedons. Where moist color values are less than 3.5, the A horizon is less than 7 inches thick.

The Bt horizon is brown, strong brown, light brown, reddish yellow, reddish brown, light reddish brown, light red, red, yellowish red, or reddish yellow. Mottles in these colors range from none to common. The texture is clay, sandy clay, or clay loam. Reaction is strongly acid or moderately acid.

The BC horizon is typically mottled in shades of red, brown, or yellow. Reaction is strongly acid or moderately acid.

The Cr layer is weakly cemented sandstone and is typically stratified with reddish, yellowish, or grayish clayey, loamy, or shaly material. Reaction is strongly acid or moderately acid.

Bonham Series

The Bonham series consists of very deep, moderately well drained, slowly permeable, loamy soils on uplands. These soils formed in clayey and loamy sediments. Slopes range from 1 to 5 percent. Bonham soils are fine, smectitic, thermic Aquic Argiudolls.

Typical pedon of Bonham silt loam, 1 to 3 percent slopes; from the junction of U.S. Highway 82 and Texas Highway 78 in Bonham, 1.4 miles west on U.S. Highway 82, 0.7 mile south on Texas Highway 121, 130 feet east of road in rangeland:

A—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and fine granular structure; slightly hard, friable, nonsticky and nonplastic ; many fine roots; many fine pores; slightly acid; clear smooth boundary.

Bt1—10 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; few fine faint brown mottles; moderate medium and fine subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; many fine roots; many fine pores; few discontinuous clay films on faces of peds; moderately acid; gradual wavy boundary.

Bt2—17 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; many fine prominent reddish brown (5YR 4/4) and many fine distinct strong brown (7.5YR 5/6) mottles; moderate coarse prismatic structure parting to moderate fine and medium angular blocky; very hard, firm, sticky and plastic; common fine roots; common very fine pores; nearly continuous clay films on faces of prisms; medium acid; gradual wavy boundary.

Bt3—30 to 42 inches; mottled light olive brown (2.5Y 5/4) and yellowish brown (10YR 5/6) silty clay; moderate coarse prismatic structure parting to moderate fine angular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few very fine

pores; continuous clay films on faces of prisms; few fine iron-manganese concretions; slightly acid; gradual wavy boundary.

Bt4—42 to 56 inches; olive brown (2.5Y 4/4) silty clay, light olive brown (2.5Y 5/4) dry; few fine and medium faint yellowish brown (10YR 5/4) and pale yellow (2.5Y 7/4) mottles; weak coarse prismatic structure parting to moderate coarse angular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few discontinuous clay films on faces of prisms; few fine iron-manganese concretions; neutral; gradual wavy boundary.

BC—56 to 65 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; common fine and medium faint gray (10YR 5/1) and common distinct dark yellowish brown (10YR 4/4) and strong brown (7.5YR 5/6) mottles; weak coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few clay films on faces of peds; few fine iron-manganese concretions; few fine pitted calcium carbonate concretions; slightly alkaline; gradual wavy boundary.

C—65 to 80 inches; light olive gray (5Y 6/2) silty clay, light gray (5Y 7/2) dry; common fine and medium distinct yellow (10YR 7/6) mottles; massive; extremely hard, very firm, sticky and plastic; few very fine pores; few fine and medium iron-manganese concretions; few fine pitted calcium carbonate concretions; noncalcareous; moderately alkaline.

The thickness of the solum ranges from 60 to 80 inches. The mollic epipedon is 12 to 20 inches thick. COLE ranges from 0.05 to 0.09 in the argillic horizon. Layers with COLE of 0.09 are less than 20 inches thick.

The A horizon is 7 to 12 inches thick and is dark brown, very dark brown, or very dark grayish brown. Reaction ranges from moderately acid to neutral.

The Bt1 horizon is dark brown, very dark brown, or very dark grayish brown. The texture is silt loam, silty clay loam, or clay loam. Reaction ranges from strongly acid to slightly acid.

The Bt2 horizon is brown, grayish brown, or dark grayish brown. It has mottles of these colors and in shades of red. The texture is silty clay loam, silty clay, or clay. Reaction ranges from moderately acid to neutral.

The Bt3 and Bt4 horizons are mottled in shades of yellow, red, olive, or brown. The texture is silty clay loam, silty clay, or clay, with 35 to 50 percent clay. Reaction ranges from slightly acid to slightly alkaline.

The BC horizon is mottled in shades of yellow, olive, gray, or brown. The texture is silty clay loam or silty clay. Reaction is slightly alkaline or moderately alkaline.

The C horizon is light olive gray, olive gray, light gray, or gray and is mottled with shades of yellow or gray. The texture is silty clay loam, silty clay, or clay. Some pedons are interbedded with shale material. Few
pitted concretions of calcium carbonate are in some pedons. Reaction is slightly alkaline or moderately alkaline.

Burleson Series

The Burleson series consists of very deep, moderately well drained, very slowly permeable, clayey soils on Pleistocene terraces. These soils formed in alkaline, clayey sediments. Slopes are 0 to 1 percent. Burleson soils are fine, smectitic, thermic Udic Haplusterts.

Typical pedon of Burleson clay, 0 to 1 percent slopes; from the junction of U.S. Highway 82 and Texas Highway 78 in Bonham, 4.4 miles south on Texas Highway 78, 200 feet west in cultivated field:

Ap—0 to 9 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine and medium subangular blocky and angular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; few fine pores; few fine black concretions; neutral; clear smooth boundary.

A—9 to 20 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine roots; few very fine pores; few wormcasts; few fine iron-manganese concretions; common shiny pressure faces; few intersecting slickensides; neutral; gradual wavy boundary.

Bss1—20 to 42 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; few wormcasts; few fine black concretions; common shiny pressure faces; common intersecting slickensides; few fine soft masses and concretions of calcium carbonate; slightly alkaline; gradual wavy boundary.

Bss2—42 to 60 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; common slickensides and shiny pressure faces; few fine iron-manganese concretions; few fine soft masses and concretions

of calcium carbonate; slightly alkaline; gradual wavy boundary.

Bss3—60 to 72 inches; grayish brown (2.5Y 5/2) clay, light brownish gray (2.5Y 6/2) dry; weak coarse angular blocky structure; very hard, very firm, very sticky and plastic; few slickensides and pressure faces; few concretions of calcium carbonate; calcareous; moderately alkaline; diffuse wavy boundary.

C—72 to 80 inches; light olive brown (2.5Y 5/4) clay, light yellowish brown (10YR 6/4) dry; massive; extremely hard, very firm, very sticky and plastic; few slickensides and pressure faces; few iron-manganese concretions; few soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. These are cyclic soils, and undisturbed areas have gilgai microrelief with microknolls 6 to about 12 inches higher than microdepressions. The distance between the microknolls and the microdepressions ranges from 5 to 15 feet. When the soils are dry, cracks 1 to 3 inches wide extend from the surface to a depth of 40 inches or more. Intersecting slickensides begin at a depth of 8 to 24 inches.

The A horizon is dark gray, very dark gray, or black. Reaction ranges from slightly acid to slightly alkaline.

The Bss horizon is black or very dark gray in the upper part and dark grayish brown, olive gray, grayish brown, or light olive gray in the lower part. Matrix chromas of 2 are below a depth of 40 inches. Reaction is slightly acid to moderately alkaline in the upper part of the horizon and slightly alkaline to moderately alkaline in the lower part.

The C horizon, where present, is light olive brown, olive brown, or olive yellow. The texture is clay or silty clay. Reaction is slightly alkaline or moderately alkaline.

Crockett Series

The Crockett series consists of very deep, moderately well drained, very slowly permeable, loamy soils on uplands. These soils formed in alkaline shales and clays. Slopes range from 1 to 5 percent. Crockett soils are fine, smectitic, thermic Udertic Paleustalfs.

Typical pedon of Crockett loam, 1 to 3 percent slopes; from the junction of Texas Highway 34 and Texas Highway 50 in Ladonia, 2.5 miles west on Texas Highway 34, 1.4 miles south on county road, 0.5 mile west on county road, and 0.2 mile south on county road, 150 feet west of road in rangeland:

A—0 to 8 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; massive; very hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; few wormcasts; slightly acid; abrupt wavy boundary.

Bt1—8 to 18 inches; mottled dark brown (10YR 4/3) and dark reddish brown (2.5YR 3/4) clay; few fine faint dark yellowish brown mottles; moderate coarse prismatic structure parting to moderate fine and medium angular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few fine pores; few wormcasts; common clay films on faces of peds; few siliceous pebbles; few iron-manganese concretions; vertical cracks partially filled with darker, less clayey soil material; slightly acid; diffuse wavy boundary.

Bt2—18 to 34 inches; mottled olive gray (5Y 4/2), olive brown (2.5Y 4/3), and yellowish brown (10YR 5/6) clay; moderate coarse angular blocky structure parting to moderate fine and medium angular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few wormcasts; few clay films on faces of peds; few siliceous pebbles; few iron-manganese concretions; few pressure faces; vertical cracks partially filled with darker, less clayey soil material; slightly acid; diffuse wavy boundary.

Bt3—34 to 46 inches; distinctly and coarsely mottled dark olive (5Y 4/3) and olive yellow (5Y 6/6) clay; weak coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; common clay films on faces of peds; few iron-manganese concretions; moderately alkaline; gradual wavy boundary.

BC—46 to 59 inches; mottled olive yellow (2.5Y 6/6) and gray (10YR 5/1) clay; weak coarse angular blocky structure; very hard, firm, sticky and plastic; few fine roots; few very fine pores; few iron-manganese concretions; moderately alkaline; gradual wavy boundary.

C—59 to 80 inches; mottled gray (10YR 5/1) and light olive brown (2.5Y 5/6) clay loam; massive; very hard, firm, slightly sticky and slightly plastic; few fine roots; few fine pores; few iron-manganese concretions; few gypsum crystals; moderately alkaline.

The solum is 40 to 60 inches thick. The clay content in the upper 20 inches of the argillic horizon is 40 to 50 percent. Secondary carbonates are below a depth of 30 inches in some pedons. When the soils are dry, cracks $^{1}/_{2}$ inch to about 2 inches wide extend from the top of the Bt horizon to a depth of 2 to 5 feet.

The A horizon is 4 to 15 inches thick and is dark

brown, very dark grayish brown, dark grayish brown, or brown. Reaction ranges from moderately acid to neutral.

The Bt1 horizon is dark brown, brown, olive brown, or light olive brown. It has common or many olive, yellowish, brownish, or reddish mottles. The texture is clay, clay loam, or sandy clay. Reaction ranges from moderately acid to neutral.

The Bt2, Bt3, and BC horizons are dark grayish brown, grayish brown, brown, dark olive gray, olive brown, olive yellow, light olive brown, dark olive, gray, olive, or light yellowish brown. They have few or common reddish, olive, yellowish, or brownish mottles. The texture is clay or clay loam. Reaction ranges from slightly acid to moderately alkaline. The BC horizon is calcareous in some pedons.

The C horizon is mottled dark gray, gray, grayish brown, light brownish gray, yellowish brown, light olive brown, yellowish brown, or brownish yellow. The texture is loam or clay loam, and some pedons are thinly interbedded with shale. Reaction is slightly alkaline or moderately alkaline. Some pedons are calcareous.

Crosstell Series

The Crosstell series consists of very deep, well drained, very slowly permeable, loamy soils on uplands. These soils formed in shales and clays. Slopes range from 2 to 12 percent. Crosstell soils are fine, smectitic, thermic Udertic Paleustalfs.

Typical pedon of Crosstell fine sandy loam, 2 to 5 percent slopes; from the junction of Farm Road 274 and Farm Road 1753 in Ravenna, 0.2 mile east on Farm Road 1753, 0.1 mile south on county road, 200 feet east of road in rangeland:

A—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; hard, very friable, nonsticky and nonplastic; many fine roots; common fine pores; moderately acid; abrupt wavy boundary.

Bt1—6 to 12 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; moderate medium angular blocky structure; extremely hard, very firm, sticky and plastic; common fine roots; few fine pores; continuous clay films on faces of peds; many cracks 1/2 to 3/4 inch wide; strongly acid; gradual smooth boundary.

Bt2—12 to 24 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; moderate coarse angular blocky structure; extremely hard, extremely firm, sticky and plastic; few fine roots; few fine pores; many clay films on faces of peds; few pressure faces; few iron-manganese concretions; many cracks 1/2 to 1 inch wide; strongly acid; gradual smooth boundary.

Bss—24 to 44 inches; dark brown (7.5YR 4/4) clay, brown (7.5YR 5/4) dry; weak coarse angular blocky structure; extremely hard, extremely firm, sticky and plastic; few fine roots; few very fine pores; common thin clay films on faces of peds; common iron-manganese concretions; common slickensides; many cracks; moderately acid; gradual smooth boundary.

C—44 to 60 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; massive; extremely hard, extremely firm, slightly sticky and plastic; few masses of soft shale with clay texture; very few fine roots; few very fine pores; common iron-manganese concretions; few gypsum crystals; neutral.

The solum is 40 to 60 inches thick.

The A horizon is 4 to 10 inches thick and is brown, dark brown, yellowish brown, very dark grayish brown, dark yellowish brown, or pale brown. Reaction ranges from moderately acid to neutral. Horizons with moist values of less than 3.5 are less than 7 inches thick.

The Bt horizon is in shades of red with or without brownish and grayish mottles. Reaction ranges from strongly acid to slightly acid. The lower part of the Bt horizon and the BC horizon, where present, are mottled in shades of brown, yellow, olive, red, or gray. Gray colors are inherited from the shale. The texture is clay or clay loam. Reaction ranges from strongly acid to neutral.

The C horizon is clay, shale, or stratified clay, shale, and weakly cemented sandstone. Soil colors are in shades of yellow, olive, gray, or brown. Reaction is neutral or slightly alkaline.

Dalco Series

The Dalco series consists of moderately deep, moderately well drained, very slowly permeable, clayey soils on uplands. These soils formed in chalk or interbedded marl and chalk. Slopes range from 1 to 5 percent. Dalco soils are fine, smectitic, thermic Leptic Udic Haplusterts.

Typical pedon of Dalco clay, in an area of Fairlie-Dalco complex, 1 to 3 percent slopes; from the junction of U.S. Highway 82 and Farm Road 100 in Honey Grove, 2.6 miles west on U.S. Highway 82, 0.3 mile south on county road, and 1.0 mile west on private road to large two-story house, 700 feet west of house in rangeland:

A1—0 to 10 inches; black (10YR 2/1) clay, very dark

gray (10YR 3/1) dry; weak fine angular blocky and subangular blocky structure; very hard, very firm, very sticky and very plastic; many fine roots; few fine pores; few fine chalk fragments; moderately alkaline; gradual wavy boundary.

A2—10 to 28 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate very fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine roots; few very fine pores; few slickensides in the lower part; few fine chalk fragments; calcareous; moderately alkaline; gradual wavy boundary.

Bss—28 to 36 inches; very dark grayish brown (2.5Y 3/2) clay, dark grayish brown (2.5Y 4/2) dry; strong coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; many intersecting slickensides and parallelepipeds; common very fine chalk fragments increasing to many in the lower 4 inches; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—36 to 46 inches; white chalk; platy in the upper 6 inches and massive in the lower part; between plates of chalk, few crevices filled with soil material; hardness of less than 3 on the Mohs scale.

The thickness of the solum ranges from 24 to about 40 inches. The texture is clay or silty clay. When the soils are dry, cracks 1 to 2 inches wide extend to a depth of 30 to 40 inches or to the chalk. Intersecting slickensides begin at a depth of about 16 inches. Reaction is slightly alkaline or moderately alkaline and calcareous.

The A horizon is 12 to 36 inches thick and is black or very dark gray.

The Bss horizon is dark gray, very dark grayish brown, or dark grayish brown.

The underlying chalk is platy and soft in the upper part in most places and massive in the lower part. The chalk has a hardness of less than 3 on the Mohs scale. It is interbedded with marl in some pedons.

Dela Series

The Dela series consists of very deep, moderately well drained, moderately rapidly permeable, loamy soils on nearly level flood plains along local streams. These soils formed in stratified, loamy alluvium. Slopes are 0 to 1 percent. Dela soils are coarse-loamy, siliceous, nonacid, thermic Typic Udifluvents.

Typical pedon of Dela loam, frequently flooded; from a crossroads in Lamasco, 0.9 mile west on Farm Road 1396, 2.8 miles south on county road, 100 feet west in native pasture:

A—0 to 10 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; common fine pores; neutral; clear smooth boundary.

C1—10 to 47 inches; brown (7.5YR 5/4) loam, strong brown (7.5YR 5/6) dry; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine pores; few bedding planes; neutral; clear smooth boundary.

C2—47 to 70 inches; brown (7.5YR 4/4) loam, brown (7.5YR 5/4) dry; few fine distinct light brownish gray (2.5Y6/2) and reddish brown (5YR 4/3) mottles; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few fine pores; few bedding planes; neutral.

The A horizon is 8 to 15 inches thick and is dark grayish brown, grayish brown, dark brown, or brown. Reaction ranges from moderately acid to neutral.

The C horizon is light brown, brown, dark brown, strong brown, reddish yellow, light yellowish brown, dark yellowish brown, or brownish yellow. The texture is loam or fine sandy loam. Reaction ranges from moderately acid to neutral. Buried horizons are below a depth of 40 inches in some pedons.

Derly Series

The Derly series consists of very deep, poorly drained, very slowly permeable, loamy soils on terraces along the Red River. These soils formed in loamy and clayey sediments. Slopes are 0 to 1 percent. Derly soils are fine, smectitic, thermic Typic Glossaqualfs.

Typical pedon of Derly silt loam, in an area of Derly-Raino complex, 0 to 1 percent slopes; from the junction of Farm Road 100 and Farm Road 273 in Monkstown, 2.8 miles north on Farm Road 100, 75 feet west in cultivated field:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; massive; very hard, friable, nonsticky and nonplastic; common fine roots; few fine pores; moderately acid; clear smooth boundary.

Btg/E—6 to 14 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry (Btg); common streaks and spots of gray (10YR 5/1) silt loam (E); few medium distinct light olive brown (2.5Y 5/4) mottles in the Btg part; moderate fine and medium subangular blocky structure; extremely hard, very firm, sticky and plastic; common fine roots; common very fine pores; few discontinuous clay

films on faces of peds; moderately acid; gradual wavy boundary.

Btg1—14 to 30 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; few medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few fine pores; common clay films on faces of peds; moderately acid; gradual wavy boundary.

Btg2—30 to 44 inches; dark gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; few fine prominent olive yellow mottles (2.5Y 6/6); moderate medium angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; common clay films on faces of peds; few pitted concretions of calcium carbonate; few salt crystals; moderately acid; gradual wavy boundary.

Btg3—44 to 56 inches; gray (10YR 5/1) clay loam, gray (10YR 6/1) dry; few fine prominent yellowish red (5YR 5/6) mottles; few tongues of light gray (10YR 7/1) material; moderate medium angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few clay films on faces of peds; neutral; gradual wavy boundary.

Btg4—56 to 80 inches; mottled light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/6) clay loam; moderate coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few very fine roots; few very fine pores; few clay films on faces of peds; few iron-manganese nodules; few fine pitted concretions of calcium carbonate; neutral; diffuse wavy boundary.

The solum is more than 80 inches thick. The content of clay in the control section averages 35 to 45 percent. The Bt horizon has no pressure faces and slickensides or few pressure faces and slickensides.

The A horizon is 4 to 7 inches thick and is very dark grayish brown, dark grayish brown, or grayish brown. Reaction is moderately acid or slightly acid. Horizons with value of 3 are less than 7 inches thick.

The E horizon, where present, is grayish brown, light gray, or light brownish gray. The texture is very fine sandy loam, loam, or silt loam. Reaction is strongly acid or moderately acid.

The Btg/E horizon is dark gray, very dark gray, gray, dark grayish brown, grayish brown, or light brownish gray. It has vertical streaks of lighter colored silt loam, loam, or very fine sandy loam, which make up 5 to 30 percent of the horizon. This horizon has few or common brownish, yellowish, or reddish mottles. Reaction is strongly acid or moderately acid.

The Btg horizon is dark gray, gray, dark grayish brown, grayish brown, or light brownish gray or is mottled in these colors and in shades of yellow or red. The number of yellowish mottles increases with depth. The texture is silty clay loam, clay loam, or clay. The soils become less acid with depth.

Elbon Series

The Elbon series consists of very deep, moderately well drained, moderately slowly permeable, loamy soils on flood plains along local streams. These soils formed in loamy alluvial sediments. Slopes are 0 to 1 percent. Elbon soils are fine, smectitic, thermic Fluventic Hapludolls.

Typical pedon of Elbon silty clay loam, frequently flooded; from the junction of U.S. Highway 82 and Farm Road 100 in Honey Grove, 3.4 miles north on Farm Road 100, 2.3 miles east on county road, 150 feet south of road in rangeland:

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; hard, firm, slightly sticky and plastic; many fine roots; common fine pores; common wormcasts; calcareous; moderately alkaline; clear smooth boundary.

A2—10 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; hard, firm, slightly sticky and plastic; many fine roots; few fine pores; common wormcasts; calcareous; moderately alkaline; clear smooth boundary.

C—22 to 80 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; massive; stratified with lighter colored clay loam; common fine roots, becoming less numerous with depth; few fine pores; calcareous; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 23 inches. Reaction is slightly alkaline or moderately alkaline and calcareous. The content of clay in the control section ranges from 35 to 45 percent.

The A horizon is very dark grayish brown or dark brown.

The C horizon is brown, dark brown, dark grayish brown, or grayish brown. It has thin strata of lighter or darker colored, coarser soil material. The texture is clay loam, silty clay loam, or silty clay.

Buried horizons of black or very dark brown silty clay loam, clay loam, or clay are below a depth of 40 inches in some pedons.

Ellis Series

The Ellis series consists of very deep, well drained, very slowly permeable, clayey soils on uplands. These soils formed in clay and shale. Slopes range from 5 to 12 percent. Ellis soils are fine, smectitic, thermic Udertic Ustochrepts.

Typical pedon of Ellis clay, 5 to 12 percent slopes, eroded; from the crossroads in Allens Chapel, 1.7 miles north on Farm Road 1396, 0.1 mile east and north on field road, 100 feet east of road in rangeland:

A—0 to 4 inches; dark grayish brown (2.5Y 4/2) clay, grayish brown (2.5Y 5/2) dry; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; common fine roots; common fine pores; neutral; clear smooth boundary.

Bss1—4 to 18 inches; dark olive gray (5Y 3/2) clay, olive gray (5Y 4/2) dry; moderate medium subangular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few fine pores; few slickensides; slightly alkaline; gradual wavy boundary.

Bss2—18 to 30 inches; mottled olive (5Y 4/4) and olive brown (2.5Y 4/4) clay, olive (5Y 5/4) and light olive brown (2.5Y 5/4) dry; moderate medium angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few slickensides; few calcium carbonate concretions; few salt crystals; moderately alkaline; gradual wavy boundary.

C—30 to 66 inches; light brownish gray (2.5Y 6/2) clay, light gray (2.5Y 7/2) dry; olive yellow (2.5Y 6/6) streaks, yellow (2.5Y 7/6) dry; massive; extremely hard, very firm, sticky and plastic; soft masses of shale; few very fine roots; few very fine pores; moderately alkaline.

The solum is 20 to 40 inches thick. The content of clay in the control section ranges from 40 to 60 percent. Few or common pressure faces and small slickensides are below the A horizon.

The A horizon is 2 to 8 inches thick. It is dark grayish brown, grayish brown, light brownish gray, olive brown, light olive brown, light yellowish brown, brown, pale brown, dark yellowish brown, or yellowish brown. Reaction is neutral or slightly alkaline.

The Bss horizon is dark olive gray, olive gray, olive, olive brown, light olive brown, or dark olive brown. The lower part of the Bss horizon is mottled in these colors in some pedons. This horizon has no calcium carbonate concretions or few calcium carbonate concretions. Reaction ranges from neutral to moderately alkaline. In some pedons the horizon is calcareous in the lower part.

The BC horizon, where present, is in shades of gray, olive, yellow, or brown. It has few or common mottles in these colors. Reaction ranges from neutral to moderately alkaline. This horizon has no calcium carbonate concretions or few or common calcium carbonate concretions.

The C horizon is mottled with colors in shades of gray, yellow, or olive. The texture is interbedded shale and clay. Reaction ranges from neutral to moderately alkaline. Gypsum crystals are between interbedded layers in some pedons.

Fairlie Series

The Fairlie series consists of deep, moderately well drained, very slowly permeable, clayey soils on uplands. These soils formed in chalk or interbedded marl and chalk. Slopes range from 0 to 3 percent. Fairlie soils are fine, smectitic, thermic Udic Haplusterts.

Typical pedon of Fairlie clay, in an area of Fairlie-Dalco complex, 1 to 3 percent slopes; from the junction of U.S. Highway 82 and Texas Highway 100 in Honey Grove, 2.6 miles west on U.S. Highway 82, 0.3 mile south on county road, 150 feet southeast in cultivated field:

Ap—0 to 8 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; weak fine angular blocky and subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; common fine pores; few fine chalk fragments; calcareous; moderately alkaline; clear smooth boundary.

Bss1—8 to 20 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; many fine roots; few fine pores; few intersecting slickensides; few chalk fragments; few fine iron-manganese nodules; calcareous; moderately alkaline; gradual wavy boundary.

Bss2—20 to 42 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine roots; few very fine pores; many intersecting slickensides; few fine chalk fragments; few fine iron-manganese nodules; few soft masses of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Bkss—42 to 54 inches; very dark grayish brown (2.5Y 3/2) clay, dark grayish brown (2.5Y 4/2) dry; few black streaks; moderate medium angular blocky structure; extremely hard, very firm, very sticky

and very plastic; few fine roots; few very fine pores; few intersecting slickensides; 3 to 5 percent fine chalk fragments; common soft masses of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—54 to 60 inches; white chalk; platy in the upper 5 inches and massive and fractured in the lower part.

The depth to a paralithic contact ranges from 40 to 60 inches. The soils are usually moist. When the soils are dry, cracks 0.4 inch to 3 inches wide extend from the surface to a depth of more than 24 inches. Intersecting slickensides begin at a depth of about 16 inches. In undisturbed areas gilgai microrelief consists of microknolls 4 to 12 inches higher than microdepressions. The texture is clay, silty clay, or silty clay loam. Reaction is slightly alkaline or moderately alkaline and typically calcareous.

The A horizon is 6 to about 20 inches thick and is black or very dark gray. In some pedons it has a few chalk fragments.

The Bss horizon is black, very dark gray, dark gray, gray, olive gray, dark olive gray, very dark grayish brown, dark grayish brown, or grayish brown. It has few or common chalk fragments.

The Cr layer is chalk or interbedded chalk and marl.

Ferris Series

The Ferris series consists of very deep, well drained, very slowly permeable, clayey soils on uplands. These soils formed in weakly consolidated, calcareous clays, marls, and shales. Slopes range from 2 to 12 percent. Ferris soils are fine, smectitic, thermic Chromic Udic Haplusterts.

Typical pedon of Ferris clay, 5 to 12 percent slopes, eroded; from the junction of Texas Highway 78 and Farm Road 271 about 1 mile south of Bonham, 1.5 miles east and south on Farm Road 271, 0.2 mile west and 0.2 mile south on county road, 600 feet east in rangeland:

A—0 to 6 inches; dark olive gray (5Y 3/2) clay, olive gray (5Y 5/2) dry; moderate fine and medium subangular blocky structure; extremely hard, very firm, very sticky and plastic; common fine roots; few fine pores; few wormcasts; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

Bss—6 to 45 inches; olive (5Y 5/3) clay, pale olive (5Y 6/3) dry; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; few very fine pores; common slickensides; few wormcasts; few fine iron-manganese nodules; common fine and medium concretions of calcium carbonate; common vertical crack fillings of dark grayish brown clayey material; common slickensides; calcareous; moderately alkaline; gradual wavy boundary.

Ck—45 to 80 inches; olive (5Y 5/3) and yellow (5Y 7/8), weakly stratified shale with clay texture; common medium prominent light gray (10YR 6/1) mottles; extremely hard, very firm, sticky and very plastic; few fine roots; few very fine pores; few bodies of powdery calcium carbonate; calcareous; moderately alkaline.

The solum is 30 to 60 inches thick. The texture is clay or silty clay. The content of clay in the solum ranges from 40 to 60 percent. Intersecting slickensides begin at a depth of 8 to 20 inches. When the soils are dry, cracks 1 to 2 inches wide extend to a depth of more than 20 inches. Cycles of microdepressions and microknolls are repeated every 6 to 20 feet across the slope.

The A horizon is 3 to 12 inches thick and is dark grayish brown, grayish brown, light olive brown, olive gray, dark olive gray, or very dark grayish brown.

The Bss horizon is olive, light olive brown, light yellowish brown, or pale olive with or without grayish, brownish, or yellowish mottles. It has few to many calcium carbonate concretions.

The C horizon is stratified light gray, light brownish gray, light olive brown, light yellowish brown, pale yellow, pale olive, olive, or yellow. Many pedons are coarsely and prominently mottled. This horizon has few or common masses of soft calcium carbonate and fine calcium carbonate concretions.

Freestone Series

The Freestone series consists of very deep, moderately well drained, slowly permeable, loamy soils on terraces along the Red River. These soils formed in clayey sediments. Slopes range from 0 to 2 percent. Freestone soils are fine-loamy, siliceous, thermic Glossaquic Paleudalfs.

Typical pedon of Freestone loam, in an area of Freestone-Hicota complex, 0 to 2 percent slopes; from the junction of Farm Road 100 and Farm Road 273 in Monkstown, 1.0 mile west on Farm Road 273, 1.0 mile south on county road to Unit 19, U.S. Forest Service National Grassland; 0.3 mile southeast on field road, 50 feet north of road between mounds in native pasture:

A—0 to 5 inches; dark yellowish brown (10YR 4/4) loam, yellowish brown (10YR 5/4) dry; few fine

faint light yellowish brown mottles; moderate medium granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine pores; common wormcasts; slightly acid; clear smooth boundary.

E—5 to 10 inches; light yellowish brown (10YR 6/4) loam, very pale brown (10YR 7/4) dry; weak fine subangular blocky structure; hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; common wormcasts; moderately acid; clear wavy boundary.

Bt1—10 to 18 inches; strong brown (7.5YR 5/6) loam, reddish yellow (7.5YR 7/6) dry; common medium prominent yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very hard, firm, slightly sticky and nonplastic; few fine roots; many fine and medium pores; common wormcasts; few discontinuous clay films on faces of peds; strongly acid; gradual wavy boundary.

Bt2—18 to 24 inches; strong brown (7.5YR 5/6) sandy clay loam; common medium prominent red (2.5YR 4/6) and gray (10YR 5/1) mottles; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few fine roots; common fine pores; common wormcasts; common clay films on faces of peds; few grains of uncoated fine sand and silt along faces of peds; strongly acid; gradual wavy boundary.

Btg/E1—24 to 30 inches; light gray (10YR 6/1) clay loam; common medium prominent dark red (2.5YR 3/6) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate angular blocky; very hard, firm, sticky and plastic; few fine roots; few fine pores; few clay films on faces of peds; about 10 percent light brownish gray (2.5Y 6/2) uncoated sand and silt grains in the form of vertical streaks and pockets 2 to 5 millimeters wide along faces of prisms; very strongly acid; diffuse wavy boundary.

Btg/E2—30 to 44 inches; mottled light gray (10YR 6/1) and dark red (2.5YR 3/6) clay loam; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and plastic; discontinuous clay films on faces of peds; about 10 percent light brownish gray (2.5Y 6/2) uncoated sand and silt grains in the form of vertical streaks and pockets 2 to 5 millimeters wide along faces of prisms; very strongly acid; diffuse wavy boundary.

Bt´1—44 to 58 inches; dark red (2.5YR 3/6) clay loam; many coarse faint dark red (10R 3/6) and prominent light gray (10YR 6/1) mottles; moderate medium prismatic structure parting to moderate coarse angular blocky; very hard, firm, sticky and plastic; few fine roots; few fine pores; discontinuous clay films on faces of peds; strongly acid; diffuse boundary.

Bt´2—58 to 80 inches; red (10R 4/6) clay loam; many coarse prominent brown (10YR 5/3) mottles; weak coarse prismatic structure parting to weak coarse angular blocky; very hard; firm, slightly sticky and plastic; discontinuous clay films on faces of peds; 5 percent vertical streaks and pockets of uncoated sand grains; strongly acid.

The solum is 60 to more than 80 inches thick. The average content of clay in the control section ranges from 20 to 35 percent.

The A horizon is 3 to 8 inches thick and is dark grayish brown, dark yellowish brown, or brown. Reaction ranges from strongly acid to slightly acid.

The E horizon is grayish brown, light brownish gray, pale brown, brown, light brown, light yellowish brown, or yellowish brown. Reaction ranges from strongly acid to slightly acid.

The Bt1 and Bt2 horizons are strong brown, yellowish brown, brownish yellow, or yellow with or without reddish or grayish mottles. Mottles with chroma of 2 or less are within 30 inches of the surface. The texture is sandy clay loam, clay loam, or loam. Reaction is strongly acid or moderately acid.

The Btg/E horizon is yellowish brown, light gray, gray, or light brownish gray. It has common or many brownish, grayish, and reddish mottles. Streaks and pockets of uncoated sand and silt grains make up 5 to 15 percent of the horizon. The texture is clay or clay loam. Reaction ranges from very strongly acid to moderately acid.

The Bt´ horizon is dark red, red, gray, light gray, or light brownish gray with brownish, yellowish, and reddish mottles. The texture is clay loam or clay. Reaction ranges from strongly acid to slightly acid.

Frioton Series

The Frioton series consists of very deep, well drained, moderately slowly permeable, loamy soils on flood plains. These soils formed in loamy and clayey alluvium. Slopes are 0 to 1 percent. Frioton soils are fine, mixed, thermic Cumulic Hapludolls.

Typical pedon of Frioton silty clay loam, occasionally flooded; from the junction of U.S. Highway 82 and Texas Highway 78 in Bonham, 3.7 miles south on Texas Highway 78, 0.3 mile east on county road, 300 feet south of road in cultivated field:

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine and medium subangular blocky

structure; hard, friable, sticky and plastic; common fine roots; common fine pores; common wormcasts; calcareous; moderately alkaline; clear smooth boundary.

A1—8 to 24 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; common fine roots; common fine pores; common wormcasts; few bedding planes; calcareous; moderately alkaline; clear smooth boundary.

A2—24 to 60 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine and medium subangular blocky structure; hard, friable, very sticky and very plastic; common fine roots; few fine pores; common wormcasts; few pockets and strata of lighter colored soil material; calcareous; moderately alkaline; clear smooth boundary.

C1—60 to 70 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; massive; hard, friable, very sticky and very plastic; few fine roots; few fine pores; common wormcasts; few very dark grayish brown (2.5Y 3/2) strata as much as 2 centimeters thick; common grayish brown (2.5Y 5/2) and brown (10YR 5/3) very fine sandy loam strata 1 to 2 millimeters thick; evident bedding planes; few fine distinct dark yellowish brown (10YR 4/4) mottles between bedding planes; calcareous; moderately alkaline; gradual smooth boundary.

C2—70 to 80 inches; dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; massive; hard, friable, sticky and plastic; few fine roots; few fine pores; few wormcasts; few dark grayish brown (2.5Y 4/2) strata as much as 2 centimeters thick; common strata of grayish brown (2.5Y 5/2) and brown (10YR 5/3) very fine sandy loam 1 to 2 millimeters thick; evident bedding planes; calcareous; moderately alkaline.

The content of clay is 35 to 50 percent in the 10- to 40-inch control section. The mollic epipedon is 24 to more than 50 inches thick. Reaction is slightly alkaline or moderately alkaline and calcareous.

The A horizon is very dark grayish brown, black, or very dark brown.

The C horizon is very dark gray, very dark grayish brown, dark brown, or dark grayish brown. The texture is silty clay loam, clay loam, or silty clay, with thin strata of black or very dark gray coarser or finer material .

Buried horizons, where present, are below a depth of 40 inches. They are black, very dark gray, very dark brown, very dark grayish brown, or dark grayish brown. The texture is silty clay loam, clay loam, or clay. Carbonates in the form of films and threads are common.

These soils are taxadjuncts to the Frioton series because the clay mineralogy is smectitic rather than mixed. The use, management, and behavior of these soils are not affected by this difference.

Heiden Series

The Heiden series consists of very deep, well drained, very slowly permeable, clayey soils on uplands. These soils formed in calcareous shales and clays. Slopes range from 2 to 6 percent. Heiden soils are fine, smectitic, thermic Udic Haplusterts.

Typical pedon of Heiden clay, 1 to 3 percent slopes; from the intersection of Texas Highway 34 and Farm Road 64 west of Ladonia, 0.4 mile southwest on Texas Highway 34, 200 feet east of road in rangeland:

A—0 to 10 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; extremely hard, very firm, very sticky and plastic; many fine roots; common fine pores; granular mulch about 6 millimeters thick on the surface; few wormcasts; few iron-manganese nodules; few fine siliceous pebbles; calcareous; moderately alkaline; abrupt smooth boundary.

Bss1—10 to 40 inches; very dark grayish brown (2.5Y 3/2) clay, dark grayish brown (2.5Y 4/2) dry; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine roots; few very fine pores; few wormcasts; few iron-manganese nodules 2 to 5 millimeters in diameter; few fine siliceous pebbles; many slickensides; in the lower part of the horizon, common intersecting slickensides that form parallelepipeds as much as 8 centimeters long; calcareous; moderately alkaline; diffuse wavy boundary.

Bss2—40 to 65 inches; olive brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) dry; weak coarse angular blocky structure parting to moderate fine angular blocky; peds are tilted 10 to 60 degrees from the horizontal; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; few wormcasts; few iron-manganese nodules; common slickensides; few fine siliceous pebbles; many vertical cracks, 2 to 5 centimeters wide, filled with A horizon material; few calcium carbonate concretions; calcareous; moderately alkaline; diffuse wavy boundary.

C—65 to 80 inches; prominently and coarsely mottled olive yellow (2.5Y 6/6), light olive brown (2.5Y 5/4),

and light olive gray (5Y 6/2), stratified clay; massive; extremely hard, very firm, sticky and very plastic; soft shale fragments; few very fine roots; few very fine pores; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 inches on the microknolls to 65 inches in the microdepressions. The content of clay in the solum ranges from 40 to 60 percent. Intersecting slickensides begin at a depth of 16 to 24 inches. When the soils are dry, cracks 1 to 2 inches wide extend to a depth of 20 inches. Cycles of microdepressions and microknolls are repeated every 4 to 12 feet across the slope. The soils are dominantly calcareous and slightly alkaline or moderately alkaline, but the upper 12 inches is noncalcareous in some pedons.

The A horizon is 10 to 18 inches thick and is very dark grayish brown, very dark gray, or dark olive gray. Where chromas are less than 1.5, the surface layer is less than 12 inches thick in more than one-half of the pedon.

The Bss horizon is dark grayish brown, grayish brown, light olive brown, yellowish brown, light yellowish brown, light olive gray, olive gray, olive, or pale olive yellow with or without yellowish or olive mottles. Calcium carbonate concretions make up as much as 2 percent of this horizon.

The C horizon is weathered, calcareous, stratified clay and soft shale. It is mottled with colors in shades of olive, yellow, brown, or gray.

Hicota Series

The Hicota series consists of very deep, moderately well drained, slowly permeable, loamy soils on terraces along the Red River. These soils formed in loamy alluvium. Slopes range from 0 to 2 percent. Hicota soils are coarse-loamy, siliceous, thermic Typic Glossudalfs.

Typical pedon of Hicota loam, in an area of Freestone-Hicota complex, 0 to 2 percent slopes; from the junction of Farm Road 100 and Farm Road 273 in Monkstown, 1.0 mile west on Farm Road 273, 1.0 mile south on county road to Unit 19, U.S. Forest Service National Grasslands, about 0.3 mile southeast on field road, 100 feet south in native pasture on mound:

A—0 to 4 inches; brown (7.5YR 5/4) loam, light brown (7.5YR 6/4) dry; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine pores; slightly acid; clear smooth boundary.

E—4 to 14 inches; light yellowish brown (10YR 6/4) loam, very pale brown (10YR 7/4) dry; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine pores; moderately acid; gradual wavy boundary.

E/Bt—14 to 26 inches; strong brown (7.5YR 5/6) loam, reddish yellow (7.5YR 6/6) dry; about 25 percent masses of yellowish red (5YR 5/6) loam 5 to 20 millimeters across (Bt); weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; common fine and medium pores; common bridged sand grains; moderately acid; clear irregular boundary.

Bt/E—26 to 32 inches; dark brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) dry; common medium distinct strong brown (7.5YR 5/6) mottles; few fine prominent grayish brown (10YR 5/2) mottles in the lower part; moderate coarse prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and slightly plastic; few fine roots; common fine and medium pores; discontinuous clay films on faces of peds; about 20 percent white (10YR 8/1) uncoated sand and silt as tongues 2 to 20 millimeters wide and 5 to 10 centimeters long along vertical faces of peds; very strongly acid; gradual smooth boundary.

Bt1—32 to 44 inches; dark brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) dry; many medium distinct light reddish brown (5YR 4/4) and many medium prominent red (2.5YR 4/6) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and slightly plastic; few roots, mainly between peds; common fine and medium pores; about 5 percent white (10YR 8/1) sand and silt along faces of prisms; many clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—44 to 54 inches; mottled red (2.5YR 5/6) and dark gray (5YR 4/1) clay loam; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few fine pores; few discontinuous clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt3—54 to 80 inches; mottled red (2.5YR 4/6), brown (7.5YR 5/2), and strong brown (7.5YR 5/6) clay loam; weak coarse angular blocky structure; hard, firm, sticky and plastic; few very fine roots; few fine pores; few thin discontinuous clay films on faces of peds; very strongly acid.

The solum is more than 80 inches thick.

The combined thickness of the A and E horizons is 7 to 26 inches. The A horizon is brown, dark grayish brown, or yellowish brown. It is moderately acid or slightly acid. The E horizon is pale brown, light

yellowish brown, yellowish brown, or strong brown. It is strongly acid to slightly acid.

The E material of the E/Bt horizon is very pale brown, light yellowish brown, yellowish brown, strong brown, light brown, or brown. Isolated bodies of Bt material make up 20 to 50 percent of the horizon and are brown, strong brown, yellowish red, or yellowish brown. The masses are fine sandy loam, very fine sandy loam, or loam. Reaction is strongly acid or moderately acid.

The Bt/E and Bt1 horizons are brown, dark brown, yellowish brown, strong brown, brownish yellow, or reddish yellow. They have few to many mottles of light reddish brown, red, or yellowish red. Few or common mottles of gray, light gray, grayish brown, or light brownish gray are below a depth of 30 inches. Tongues and vertical streaks of uncoated sand and silt grains make up about 15 to 40 percent of these horizons. The horizons are very fine sandy loam, loam, or clay loam. The average content of clay in the control section ranges from 8 to 18 percent. Reaction ranges from very strongly acid to moderately acid.

The Bt2, Bt3, and Bt4 horizons are mottled in shades of gray, yellow, brown, or red. A few thin streaks and pockets of uncoated sand and silt grains are in most pedons. The texture is clay loam, sandy clay loam, or clay. Reaction ranges from very strongly acid to moderately acid.

Hopco Series

The Hopco series consists of very deep, somewhat poorly drained, moderately slowly permeable, loamy soils on flood plains along local streams. These soils formed in loamy alluvium. Slopes range from 0 to 2 percent. Hopco soils are fine-silty, mixed, thermic Cumulic Haplaquolls.

Typical pedon of Hopco silt loam, frequently flooded; from the junction of Farm Road 898 and Texas Highway 121 about 2 miles northwest of Bonham, 0.1 mile south on Texas Highway 121, 100 feet east of highway, in rangeland:

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and nonplastic; many fine roots; common fine pores; moderately alkaline; clear wavy boundary.

A2—8 to 30 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and nonplastic; many fine roots; common fine pores; moderately alkaline; gradual wavy boundary.

A3—30 to 45 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; few fine prominent reddish brown (5YR 4/4) mottles; moderate medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; few bedding planes; moderately alkaline; gradual wavy boundary.

Bw—45 to 80 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; few fine distinct olive brown (2.5Y 4/4) and dark gray (10YR 5/1) mottles; weak medium angular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; calcareous; moderately alkaline.

The solum is more than 80 inches thick. The control section averages 25 to 35 percent clay, with less than 15 percent fine sand or coarser material. The control section is neutral to moderately alkaline and is noncalcareous throughout.

The A horizon is 24 to 60 inches thick and is very dark grayish brown or very dark gray. The lower part of the A horizon has few or common reddish brown, brown, dark yellowish brown, or yellowish brown mottles.

The Bw horizon is very dark grayish brown, brown, dark brown, dark grayish brown, or dark gray. It has few or common reddish brown, olive brown, or gray mottles. The texture is silt loam or silty clay loam.

Houston Black Series

The Houston Black series consists of very deep, moderately well drained, very slowly permeable, clayey soils on uplands. These soils formed in calcareous clays and marls. Slopes range from 1 to 3 percent. Houston Black soils are fine, smectitic, thermic Udic Haplusterts.

Typical pedon of Houston Black clay, 1 to 3 percent slopes; from the junction of U.S. Highway 82 and Farm Road 824 in Honey Grove, 2.2 miles south on Farm Road 824, 2.9 miles east on county road, 200 feet north in cultivated field:

Ap—0 to 8 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; extremely hard, very firm, very sticky and very plastic; many fine roots; common wormcasts; few snail fragments; few iron-manganese nodules; few fine strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

A—8 to 17 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate very fine and fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine roots; few fine pores; few wormcasts; few snail fragments; many very fine shiny faces of peds; few iron-manganese nodules; few fine strongly cemented calcium carbonate concretions; calcareous; moderately alkaline; gradual wavy boundary.

Bss—17 to 37 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine and very fine angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; few fine pores; few wormcasts; many fine shiny faces of peds; few iron-manganese nodules; few fine strongly cemented concretions of calcium carbonate; common coarse grooved intersecting slickensides; calcareous; moderately alkaline; gradual wavy boundary.

Bssk1—37 to 75 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; common medium distinct light olive brown (2.5Y 5/4) and common medium faint dark gray (10YR 4/1) mottles; common vertical streaks of dark gray (10YR 4/1) clayey material; moderate very fine and fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; few wormcasts; many fine shiny faces of peds; common iron-manganese nodules; common strongly cemented concretions of calcium carbonate as much as 8 millimeters across; common coarse intersecting slickensides; calcareous; moderately alkaline; gradual wavy boundary.

Bssk2—75 to 80 inches; dark yellowish brown (10YR 4/4) clay, yellowish brown (10YR 5/4) dry; common medium distinct olive brown (2.5Y 4/4) and dark gray (10YR 4/1) mottles; moderate coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few very fine pores; many shiny faces of peds; few slickensides; common iron-manganese nodules; common concretions of calcium carbonate; calcareous; moderately alkaline.

The solum is more than 60 inches thick. The content of clay in the solum ranges from 45 to 60 percent. Intersecting slickensides begin at a depth of 16 to 24 inches. When the soils are dry, cracks 1 to 2 inches wide extend to a depth of 20 inches. Cycles of microdepressions and microknolls are repeated every 10 to 24 feet. The soils are dominantly calcareous and moderately alkaline but are slightly alkaline in the upper 12 inches in some pedons.

The A horizon is 15 to 40 inches thick and is black or very dark gray.

The Bss horizon is very dark grayish brown, dark yellowish brown, dark grayish brown, grayish brown, light brownish gray, pale yellow, light yellowish brown, light olive brown, olive gray, olive, or pale olive. In most pedons it has few or common grayish, brownish, or yellowish mottles.

Howe Series

The Howe series consists of moderately deep, well drained, moderately permeable, loamy soils on uplands. These soils formed in chalk or in chalk interbedded with marl. Slopes range from 3 to 12 percent. Howe soils are fine-silty, carbonatic, thermic Udic Ustochrepts.

Typical pedon of Howe clay loam, in an area of Howe-Whitewright complex, 3 to 5 percent slopes; from the junction of U.S. Highway 69 and Texas Highway 121 in Trenton, 0.4 mile east on Texas Highway 121, 0.6 mile north on county road, 200 feet east in pasture:

A—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky and granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; calcareous; moderately alkaline; gradual smooth boundary.

Bk1—8 to 16 inches; grayish brown (10YR 5/2) clay loam, light gray (10YR 7/2) dry; moderate fine subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine roots; common fine pores; few fine chalk fragments; calcareous; moderately alkaline; gradual wavy boundary.

Bk2—16 to 27 inches; pale brown (10YR 6/3) clay loam, very pale brown (10YR 7/3) dry; moderate fine subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine and medium chalk fragments; few fine roots; few fine pores; calcareous; moderately alkaline; gradual wavy boundary.

Cr—27 to 40 inches; very pale brown (10YR 7/3), brittle marl interbedded with chalk; very pale brown (10YR 8/3) dry.

The thickness of the solum ranges from 20 to 40 inches. The calcium carbonate equivalent in the control section ranges from 40 to about 80 percent.

The texture is clay loam, silty clay loam, or silty clay, with a total clay content ranging from 30 to 45 percent and a silicate clay content ranging from 25 to 35 percent.

The A horizon is 5 to 13 inches thick and is dark grayish brown, grayish brown, dark brown, brown, light brownish gray, or pale brown.

The Bk horizon is grayish brown, light brownish gray, brown, pale brown, light yellowish brown, or olive brown. It has no chalk fragments or few chalk fragments in the upper part and 5 to 35 percent, by volume, chalk fragments in the lower part.

The Cr layer is white, light gray, very pale brown, or light brownish gray, weakly cemented, platy chalk or brittle marl. The chalk becomes more massive and less fractured with depth.

Ivanhoe Series

The Ivanhoe series consists of very deep, somewhat poorly drained, very slowly permeable, loamy soils on stream terraces. These soils formed in clayey alluvium. Slopes are 0 to 1 percent. Ivanhoe soils are fine, smectitic, thermic Aeric Ochraqualfs.

Typical pedon of Ivanhoe silt loam, 0 to 1 percent slopes; from the junction of Farm Road 898 and Farm Road 1396 about 9 miles north of Bonham, 1.2 miles east on Farm Road 1396, 200 feet north of right-of-way in cultivated field:

Ap—0 to 5 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; hard, friable, nonsticky and nonplastic; common fine roots; many fine pores; slightly acid; clear smooth boundary.

A—5 to 13 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; few fine distinct reddish brown (5YR 4/4) mottles; massive; hard, friable, nonsticky and nonplastic; common fine roots; many fine pores; slightly acid; clear wavy boundary.

Bt1—13 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct reddish brown (5YR 4/4) mottles; weak coarse subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few fine roots; common fine pores; discontinuous clay films on faces of peds; moderately acid; clear wavy boundary.

Bt2—17 to 33 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; many fine distinct reddish brown (5YR 4/4) mottles; weak coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; discontinuous clay films on faces of peds; few pressure faces; few medium iron-manganese nodules; slightly acid; gradual wavy boundary.

Btg1—33 to 51 inches; dark grayish brown (2.5Y 4/2) clay, grayish brown (10YR 5/2) dry; weak coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots, mainly between peds; few very fine pores; few clay films on faces of peds; few pressure faces; few medium iron-manganese nodules; slightly alkaline; gradual wavy boundary.

Btg2—51 to 68 inches; grayish brown (2.5Y 5/2) clay, light grayish brown (2.5Y 6/2) dry; few medium prominent strong brown (7.5YR 5/6) mottles; weak coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; thin discontinuous clay films on faces of peds; few pressure faces; few fine and medium iron-manganese nodules; few soft masses of calcium carbonate; slightly alkaline; gradual wavy boundary.

BCg—68 to 84 inches; light gray (5Y 6/1) clay, light gray (5Y 7/1) dry; few fine distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; very hard, very firm, sticky and plastic; few fine masses of barite; slightly alkaline.

The solum is more than 80 inches thick. The content of clay in the control section ranges from 37 to 47 percent. The depth to a dense clayey layer with more than 40 percent clay ranges from 12 to about 20 inches. The argillic horizon has no iron-manganese concretions or nodules or few iron-manganese concretions 2 to 10 millimeters in diameter throughout.

The A horizon is 10 to 16 inches thick and is brown, dark brown, grayish brown, or dark grayish brown. Reaction ranges from moderately acid to neutral.

The Bt1 horizon is very dark grayish brown, dark grayish brown, dark brown, or brown. It has few to many yellowish, grayish, or brownish mottles. The texture is silty clay loam, clay loam, or loam. Reaction ranges from moderately acid to neutral.

The Bt2 horizon is very dark grayish brown or dark grayish brown. It has common or many reddish brown or brown mottles. The texture is clay or silty clay. Reaction is moderately acid or slightly acid.

The Btg1 horizon is very dark grayish brown, dark grayish brown, dark olive gray, or olive gray. The texture is clay or silty clay. Reaction ranges from neutral to moderately alkaline.

The Btg2 horizon is dark grayish brown, grayish brown, or olive gray. It has no mottles or few or

common brownish and yellowish mottles. The texture is clay or silty clay. Reaction is slightly alkaline or moderately alkaline.

The BCg horizon is light gray, gray, olive gray, grayish brown, or light grayish brown, with or without mottles in shades of brown or yellow. The texture is clay or silty clay. Reaction is slightly alkaline or moderately alkaline.

Karma Series

The Karma series consists of very deep, well drained, moderately permeable, loamy soils on terraces along the Red River. These soils formed in loamy sediments. Slopes range from 0 to 12 percent. Karma soils are fine-loamy, mixed, thermic Typic Hapludalfs.

Typical pedon of Karma loam, 0 to 2 percent slopes; north of Honey Grove on Farm Road 100 to Riverby Ranch Headquarters, 1 mile north on private road, 100 feet west of road in cultivated field:

Ap—0 to 8 inches; dark brown (7.5YR 4/4) loam, brown (7.5YR 5/4) dry; weak medium granular structure; hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; common wormcasts; slightly acid; abrupt smooth boundary.

Bt1—8 to 28 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; few wormcasts; many clay films on faces of peds; common bridging of sand grains; moderately acid; gradual smooth boundary.

Bt2—28 to 44 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few fine roots; few fine pores; common clay films on faces of peds; common bridging of sand grains; few iron-manganese nodules; moderately acid; gradual smooth boundary.

BC—44 to 80 inches; yellowish red (5YR 5/6) fine sandy loam, reddish yellow (5YR 6/6) dry; weak medium granular structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few fine pores; thin discontinuous clay films on faces of peds; common bridging of sand grains; few soft iron-manganese nodules; 2 to 4 percent, by volume, pockets of uncoated sand grains; moderately acid.

The solum is 60 to more than 80 inches thick. The content of clay in the control section ranges from 25 to 35 percent. Reaction is moderately acid to slightly alkaline.

The A horizon is 6 to 12 inches thick and is brown, dark brown, grayish brown, dark grayish brown, reddish brown, or dark reddish brown.

The Bt horizon is reddish brown, yellowish red, or red. The texture is sandy clay loam or clay loam.

The BC horizon is yellowish red or red. The texture is fine sandy loam, loam, or sandy clay loam. Pockets of uncoated sand grains make up about 1 to 4 percent of the volume.

Kiomatia Series

The Kiomatia series consists of very deep, well drained, rapidly permeable, sandy soils on the flood plain along the Red River. These soils formed in sandy alluvium. Slopes range from 0 to 5 percent. Kiomatia soils are sandy, mixed, thermic Typic Udifluvents.

Typical pedon of Kiomatia loamy fine sand, in an area of Oklared-Kiomatia complex, occasionally flooded; north of Honey Grove on Farm Road 100 to the Riverby Ranch Headquarters, 2.1 miles north on field road, 0.7 mile west on field road, 3,500 feet north in improved pasture.

A—0 to 9 inches; reddish brown (5YR 5/4) loamy fine sand, light reddish brown (5YR 6/4) dry; weak fine granular structure and single grained; soft, very friable, nonsticky and nonplastic; few fine roots; many fine pores; common thin light reddish brown strata in the lower part; calcareous; moderately alkaline; clear smooth boundary.

C—9 to 60 inches; reddish brown (5YR 5/4) fine sand, light reddish brown (5YR 6/4) dry; loose, nonsticky and nonplastic; few fine roots; common fine pores; few thin strata of loamy fine sand and fine sandy loam; calcareous; moderately alkaline.

The soils are calcareous and moderately alkaline throughout the profile. The 10- to 40-inch control section is fine sand or loamy fine sand stratified with loamy very fine sand.

The A horizon is 2 to 10 inches thick and is reddish brown, brown, light brown, or pink.

The C horizon is reddish brown, light reddish brown, reddish yellow, pink, or strong brown. The texture is loamy fine sand or fine sand.

Konawa Series

The Konawa series consists of very deep, well drained, moderately permeable, loamy soils on terraces along the Red River. These soils formed in

loamy sediments. Slopes range from 5 to 8 percent. Konawa soils are fine-loamy, mixed thermic Ultic Halpustalfs.

Typical pedon of Konawa fine sandy loam, 5 to 8 percent slopes; from the junction of Farm Road 274 and Farm Road 1753 in Ravenna, 2.1 miles west on Farm Road 1753, 1.9 miles north on county road, 300 feet north-northwest in rangeland:

A—0 to 14 inches; dark yellowish brown (10YR 3/4) fine sandy loam, dark yellowish brown (10YR 4/4) dry; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; common fine pores; slightly acid; clear smooth boundary.

Bt1—14 to 36 inches; dark red (2.5YR 3/6) sandy clay loam, red (2.5YR 4/6) dry; moderate fine and medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; few clay films on faces of peds; moderately acid; gradual smooth boundary.

Bt2—36 to 48 inches; red (2.5YR 4/6) sandy clay loam, red (2.5YR 5/6) dry; weak fine subangular blocky structure; hard; friable, slightly sticky and slightly plastic; common fine roots; common fine pores; thin clay films on faces of peds; moderately acid; gradual smooth boundary.

BC—48 to 80 inches; yellowish red (5YR 5/8) fine sandy loam, reddish yellow (5YR 6/8) dry; weak coarse granular structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; common fine pores; slightly acid.

The thickness of the solum ranges from 48 to more than 72 inches. The content of clay in the control section ranges from 20 to 30 percent.

The A horizon is 8 to 16 inches thick and is brown, yellowish brown, dark yellowish brown, brownish yellow, dark grayish brown, grayish brown, or light brown. Reaction is moderately acid or slightly acid.

The Bt horizon is red, dark red, reddish brown, dark reddish brown, or yellowish red. The texture is sandy clay loam or fine sandy loam. Reaction is strongly acid or moderately acid.

The BC horizon is reddish yellow, red, or yellowish red. The texture is sandy clay loam, fine sandy loam, or loamy fine sand. Reaction ranges from moderately acid to neutral.

Lamar Series

The Lamar series consists of very deep, well drained, moderately permeable, loamy soils on uplands. These soils formed in calcareous, loamy sediments. Slopes range from 5 to 8 percent. Lamar soils are fine-silty, mixed, thermic Udic Ustochrepts.

Typical pedon of Lamar clay loam, 5 to 8 percent slopes; from the junction of U.S. Highway 82 and Texas Highway 78 in Bonham, 3.6 miles south on Texas Highway 78, 800 feet west in rangeland (about 200 feet west of old barn):

A—0 to 4 inches; dark brown (10YR 4/3) clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky and strong fine granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; common wormcasts and channels; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Bk1—4 to 26 inches; yellowish brown (10YR 5/4) silty clay loam, brownish yellow (10YR 6/4) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; few wormcasts and channels; 8 to 10 percent, by volume, concretions of calcium carbonate; few small shell fragments; calcareous; moderately alkaline; clear smooth boundary.

Bk2—26 to 37 inches; yellowish brown (10YR 5/6) silty clay loam, brownish yellow (10YR 6/6) dry; common medium faint olive yellow (2.5Y 6/6) mottles; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; few wormcasts and channels; 10 to 15 percent, by volume, concretions of calcium carbonate; calcareous; moderately alkaline; diffuse wavy boundary.

Ck—37 to 80 inches; yellowish brown (10YR 5/6) silty clay loam, brownish yellow (10YR 6/6) dry; massive; hard, firm, nonsticky and nonplastic; few angular cleavage planes; few fine roots; few fine pores; few wormcasts and channels; 5 to 10 percent, by volume, soft masses of calcium carbonate; few marine shells; calcareous; moderately alkaline.

The thickness of the solum ranges from 26 to 50 inches. The content of clay in the control section ranges from 20 to 35 percent.

The A horizon is 2 to 10 inches thick and is dark grayish brown, grayish brown, light brownish gray, dark brown, or brown.

The Bk horizon is grayish brown, yellowish brown, light yellowish brown, brownish yellow, light olive brown, or olive yellow. The texture is loam, clay loam, or silty clay loam. Films, threads, and concretions of

calcium carbonate make up 5 to 20 percent, by volume, of the horizon.

The Ck horizon has the same colors and textures as the B horizon. Common bands of weathered shale containing marine fossils are in some pedons. Soft masses of powdery lime and calcium carbonate concretions make up 3 to 15 percent of the horizon.

Larton Series

The Larton series consists of very deep, well drained, moderately permeable, sandy soils on stream terraces. These soils formed in loamy sediments. Slopes range from 0 to 2 percent. Larton soils are loamy, siliceous, thermic Arenic Paleudalfs.

Typical pedon of Larton loamy fine sand, 0 to 2 percent slopes; from the junction of Farm Road 273 and Farm Road 100 in Monkstown, 0.1 mile south on Farm Road 100, 300 feet west in pasture:

A—0 to 9 inches; dark brown (10YR 4/3) loamy fine sand, brown (10YR 5/3) dry; single grained; loose, nonsticky and nonplastic; many fine roots; many fine pores; slightly acid; abrupt smooth boundary.

E—9 to 23 inches; dark yellowish brown (10YR 4/4) loamy fine sand, yellowish brown (10YR 5/4) dry; single grained; loose, nonsticky and nonplastic; many fine roots; many fine pores; slightly acid; clear wavy boundary.

Bt1—23 to 36 inches; strong brown (7.5YR 5/6) sandy clay loam, reddish yellow (7.5YR 6/6) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; discontinuous clay films on faces of peds; moderately acid; gradual smooth boundary.

Bt2—36 to 60 inches; reddish yellow (7.5YR 6/6) sandy clay loam, reddish yellow (7.5YR 7/6) dry; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few discontinuous clay films on faces of peds; moderately acid; clear smooth boundary.

Bt3—60 to 80 inches; brownish yellow (10YR 6/8) loam, yellow (10YR 7/8) dry; many coarse prominent yellowish red (5YR 5/6) mottles; weak coarse granular structure; slightly hard, friable, nonsticky and nonplastic; few pockets of clean sand grains; slightly acid.

The thickness of the solum ranges from 60 to 80 inches.

The A horizon is 6 to 9 inches thick and is very dark grayish brown, brown, dark brown, dark yellowish brown, dark grayish brown, grayish brown, yellowish brown, light brownish gray, pale brown, light yellowish brown, or light brown. Reaction ranges from strongly acid to slightly acid.

The E horizon is brown, dark yellowish brown, dark grayish brown, grayish brown, yellowish brown, light brownish gray, pale brown, light yellowish brown, very pale brown, pinkish gray, light brown, or pink. Reaction is strongly acid to slightly acid.

The Bt horizon is strong brown, reddish yellow, brownish yellow, or yellowish red. The texture is loam or sandy clay loam. Reaction is moderately acid or slightly acid.

Leson Series

The Leson series consists of very deep, moderately well drained, very slowly permeable, clayey soils on uplands. These soils formed in shales and clays. Slopes range from 1 to 3 percent. Leson soils are fine, smectitic, thermic Udic Haplusterts.

Typical pedon of Leson clay, 1 to 3 percent slopes; from the junction of Texas Highways 11 and 78 in Bailey, 2.5 miles east on Texas Highway 11, 200 feet south in rangeland:

A—0 to 14 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; weak coarse angular blocky structure parting to moderate fine angular blocky; extremely hard, very firm, very sticky and very plastic; many fine roots; few fine pores; few wormcasts; few fine black nodules; common shiny pressure faces; few intersecting slickensides; neutral; gradual wavy boundary.

Bss1—14 to 36 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; few fine distinct yellowish brown (10YR 5/4) mottles; moderate coarse angular blocky structure parting to moderate fine angular blocky; extremely hard, very firm, very sticky and very plastic; common fine roots; few fine pores; few wormcasts; few fine iron-manganese nodules; common shiny pressure faces; many grooved intersecting slickensides and wedge-shaped aggregates having long axes tilted 30 to 45 degrees from the horizontal; neutral; gradual wavy boundary.

Bss2—36 to 48 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; few fine and medium iron-manganese nodules; common shiny pressure faces; common intersecting slickensides; slightly alkaline; gradual wavy boundary.

Bkss—48 to 70 inches; mottled dark grayish brown (10YR 4/2) and brown (10YR 5/3) clay; weak coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; few fine iron-manganese nodules; few soft masses of calcium carbonate; common shiny faces of peds; few slickensides; calcareous; moderately alkaline; gradual wavy boundary.

Ck—70 to 80 inches; mottled brown (10YR 5/3) and yellowish brown (10YR 5/6), stratified clay; massive; extremely hard, very firm, sticky and very plastic; few soft shale fragments; few fine roots; few very fine pores; few fine soft masses of calcium carbonate; common iron-manganese nodules; calcareous; moderately alkaline.

The solum is 40 to 80 inches thick. The content of clay in the solum ranges from 45 to 60 percent. When the soils are dry, cracks 1 to 3 inches wide extend to a depth of 20 inches. Common or many intersecting slickensides are below a depth of 14 inches. The distance between microknolls and microdepressions is 4 to 16 feet.

The A horizon is black or very dark gray. In some pedons it has a few brownish or olive mottles in the lower part. Reaction ranges from slightly acid to moderately alkaline.

The Bss horizon is very dark grayish brown, dark grayish brown, grayish brown, olive gray, olive, or pale olive. It has no mottles or few to many grayish, brownish, or yellowish mottles. Reaction ranges from neutral to moderately alkaline. In some pedons this horizon is calcareous.

The Ck horizon is grayish brown, light brownish gray, light olive brown, brown, light yellowish brown, light olive gray, olive, or pale olive. It has common or many brownish, grayish, olive, or yellowish mottles. Reaction is slightly alkaline or moderately alkaline.

Lewisville Series

The Lewisville series consists of very deep, well drained, moderately permeable, clayey soils on uplands. These soils formed in calcareous, loamy sediments. Slopes range from 1 to 3 percent. Lewisville soils are fine-silty, mixed, thermic Udic Calciustolls.

Typical pedon of Lewisville silty clay, 1 to 3 percent slopes; from the junction of Texas Highway 121 and Texas Highway 11 in Randolph, 5.4 miles west on Texas Highway 11, 0.1 mile south on county road, 200 feet west in rangeland:

A—0 to 14 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many fine roots; many fine pores; calcareous; moderately alkaline; gradual smooth boundary.

Bk1—14 to 28 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; many fine roots; common fine pores; about 5 percent, by volume, fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Bk2—28 to 50 inches; yellowish brown (10YR 5/6) silty clay, brownish yellow (10YR 6/6) dry; moderate fine subangular blocky structure; hard, friable, sticky and plastic; common fine roots; many fine pores; about 10 to 20 percent, by volume, fine concretions of calcium carbonate; calcareous; moderately alkaline; diffuse smooth boundary.

Bk3—50 to 80 inches; brownish yellow (10YR 6/6) silty clay, yellow (10YR 7/6) dry; weak fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine pores; few fine calcium carbonate concretions; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to 80 inches. The texture is clay loam, silty clay loam, or silty clay. The content of silicate clay in the 10- to 40-inch control section ranges from 25 to 35 percent. The calcium carbonate equivalent in the control section ranges from 20 to 40 percent.

The A horizon is 10 to 20 inches thick and is very dark grayish brown or dark brown.

The Bk1 horizon is light brown, strong brown, pale brown, brown, grayish brown, dark yellowish brown, or yellowish brown.

The Bk2 and Bk3 horizons are dark yellowish brown, yellowish brown, light yellowish brown, or brownish yellow.

Morse Series

The Morse series consists of very deep, well drained, very slowly permeable, clayey soils on terraces along the Red River. These soils formed in clayey sediments. Slopes range from 5 to 12 percent. Morse soils are fine, mixed, thermic Chromic Hapluderts.

Typical pedon of Morse clay, 5 to 12 percent slopes, eroded; from the junction of Farm Road 273 and Farm Road 2029 in Telephone, 2.7 miles west on Farm Road 273, 1.0 mile south on county road, 0.3 mile

east on private road, 100 feet west of road in rangeland:

A—0 to 4 inches; dark brown (7.5YR 3/2) clay, dark brown (7.5YR 4/2) dry; weak fine subangular blocky structure; very hard, very firm, sticky and plastic; many fine roots; common fine pores; calcareous; moderately alkaline; clear wavy boundary.

Bkss1—4 to 16 inches; yellowish red (5YR 4/6) clay, reddish brown (5YR 4/4) dry; moderate fine angular blocky structure; very hard, very firm, sticky and plastic; common fine roots; few fine pores; common intersecting slickensides; common concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Bkss2—16 to 28 inches; red (2.5YR 4/6) clay, red (2.5YR 5/6) dry; moderate fine angular blocky structure; very hard, very firm, sticky and plastic; few fine roots; few very fine pores; common intersecting slickensides; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C—28 to 80 inches; red (2.5YR 4/6) clay, red (2.5YR 5/6) dry; weak coarse angular blocky structure; very hard, very firm, sticky and plastic; few fine roots; few very fine pores; calcareous; moderately alkaline.

The solum is 24 to 28 inches thick. The soils have common or many intersecting slickensides. Areas have gilgai relief with a maximum difference between the microswales and microridges of about 6 inches.

The A horizon is 2 to 8 inches thick and is dark brown or dark reddish brown.

The Bkss horizon is reddish brown, yellowish red, or red. The texture is clay or silty clay.

The texture of the C horizon is clay or silty clay.

Muldrow Series

The Muldrow series consists of very deep, somewhat poorly drained, very slowly permeable, loamy soils on stream terraces along the Red River. These soils formed in clayey sediments. Slopes are 0 to 1 percent. Muldrow soils are fine, mixed, thermic Typic Argiaquolls.

Typical pedon of Muldrow clay loam, rarely flooded; north of Honey Grove on Farm Road 100 to Riverby Ranch Headquarters, 0.6 mile north on private road, 500 yards east in cultivated field:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; very hard, very firm, slightly sticky and slightly plastic; common fine roots; common fine pores; few wormcasts and tubular channels; neutral; clear smooth boundary.

A—6 to 16 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; few fine and medium prominent reddish brown (5YR 4/3) mottles; moderate coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; common fine roots; few fine pores; few clay films on faces of peds; common pressure faces; few fine black concretions; neutral; gradual smooth boundary.

Btg1—16 to 24 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; few fine and medium prominent reddish brown (5YR 4/3) mottles; moderate coarse angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few clay films on faces of peds; common pressure faces; few fine iron-manganese nodules; slightly alkaline; gradual smooth boundary.

Btg2—24 to 60 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; common medium prominent reddish brown (5YR 4/4) and common medium faint dark gray (10YR 4/1) mottles; moderate coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; common clay films on faces of peds; few fine and medium iron-manganese concretions; few medium siliceous pebbles; few fine concretions of calcium carbonate in the lower part; slightly alkaline; gradual smooth boundary.

BCg—60 to 80 inches; dark gray (10YR 4/1) clay loam, light gray (10YR 6/1) dry; common medium distinct yellowish brown (10YR 5/6), common medium faint light gray (10YR 7/1), and few fine prominent dark reddish brown (5YR 3/4) mottles; moderate medium prismatic structure parting to weak coarse angular blocky; extremely hard, very firm, sticky and plastic; few fine roots, mainly along faces of peds; few dark gray clay films on faces of prisms; common fine and medium iron-manganese concretions; few fine and medium concretions of calcium carbonate; calcareous; moderately alkaline.

The solum is more than 50 inches thick. The content of clay in the control section ranges from 35 to 45 percent.

The A horizon is 10 to 20 inches thick and is very dark grayish brown, very dark brown, or dark brown. Reaction is strongly acid or moderately acid.

The Btg horizon is very dark grayish brown or very dark brown. It has few or common mottles of yellowish

brown, dark gray, strong brown, or reddish brown. The texture is clay, silty clay, or silty clay loam. The content of clay averages 35 to 50 percent. Reaction is slightly acid or neutral.

The BCg horizon is dark gray or gray. It has few or common mottles of yellowish brown, strong brown, reddish brown, light gray, or gray. The texture is clay loam, silty clay loam, silty clay, or clay. Reaction ranges from neutral to moderately alkaline.

Normangee Series

The Normangee series consists of very deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in shales and clays. Slopes range from 1 to 5 percent. Normangee soils are fine, smectitic, thermic Udertic Haplustalfs.

Typical pedon of Normangee clay loam, 1 to 3 percent slopes; from the junction of Texas Highway 78 and U.S. Highway 82 in Bonham, 1.9 miles west on U.S. Highway 82, 0.9 mile south on county road, 0.2 mile west on county road, 200 feet south in rangeland:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; common fine roots; common fine pores; few fine wormcasts and channels; slightly acid; clear smooth boundary.

Bt1—6 to 21 inches; dark brown (10YR 4/3) clay, brown (10YR 5/3) dry; common fine prominent reddish brown (5YR 4/4) and few medium faint dark grayish brown (10YR 4/2) mottles; moderate medium angular blocky structure; very hard, firm, sticky and plastic; common fine roots; few fine pores; common clay films on faces of peds; few fine and medium iron-manganese concretions; neutral; clear smooth boundary.

Bt2—21 to 39 inches; dark brown (10YR 4/3) clay, brown (10YR 5/3) dry; common medium distinct dark yellowish brown (10YR 4/4) and dark brown (7.5YR 4/4) and few fine prominent reddish brown (5YR 4/4) and yellowish red (5YR 4/6) mottles; moderate medium angular blocky structure; hard, firm, sticky and plastic; few fine roots; few very fine pores; common clay films on faces of peds; few fine and medium iron-manganese concretions; few slickensides; few vertical cracks filled with dark grayish brown (10YR 4/2) clay loam; moderately alkaline; gradual smooth boundary.

Bt3—39 to 55 inches; mottled olive yellow (2.5Y 6/6), dark olive gray (5Y 3/2), gray (5Y 6/1), and reddish brown (5YR 4/4) clay; moderate coarse angular blocky structure parting to moderate fine angular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few fine and medium iron-manganese concretions; few clay films on faces of peds; few slickensides; few vertical cracks filled with dark grayish brown (2.5Y 4/2) clay loam with common fine prominent reddish brown mottles (2.5YR 4/4); moderately alkaline; gradual wavy boundary.

C—55 to 80 inches; olive gray (5Y 5/2) clay; common fine distinct light olive brown (2.5Y 5/6) and few fine distinct yellowish brown (10YR 5/6) mottles; massive; extremely hard, very firm, sticky and very plastic; few fragments of weathered shale; common cleavage planes; few fine roots; few very fine pores; few fine iron-manganese masses; few coarse concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. The depth to secondary carbonates is more than 30 inches.

The A horizon is 4 to 9 inches thick and is dark brown or dark grayish brown. Reaction is slightly acid or neutral.

The Bt1 horizon is brown, dark brown, or yellowish brown. It has few or common reddish or brownish mottles. Reaction ranges from moderately acid to neutral.

The Bt2 and Bt3 horizons are dark brown, grayish brown, brown, olive, olive yellow, dark olive gray, gray, dark yellowish brown, olive brown, yellowish brown, light olive brown, or light yellowish brown with mottles of these colors and in shades of red, or the horizons are mottled and have no matrix color. The texture is clay or clay loam. Reaction ranges from slightly acid to slightly alkaline in the upper part and from neutral to moderately alkaline in the lower part. Few or common calcium carbonate concretions and gypsum crystals are in the lower part of the Bt horizon in some pedons.

The C horizon is mottled in shades of olive, gray, yellow, or brown. Reaction ranges from neutral to moderately alkaline. Calcium carbonate concretions and gypsum crystals are in most pedons.

Norwood Series

The Norwood series consists of very deep, well drained, moderately permeable, loamy soils on flood plains along the Red River. These soils formed in calcareous, loamy alluvium. Slopes are 0 to 1 percent. Norwood soils are fine-silty, mixed (calcareous), thermic Typic Udifluvents.

Typical pedon of Norwood silt loam, rarely flooded; north of Honey Grove on Farm Road 100 to Riverby Ranch Headquarters, 1.4 miles north on field road, 200 feet east in cultivated field:

Ap—0 to 9 inches; brown (7.5YR 5/4) silt loam, light brown (7.5YR 6/4) dry; weak fine subangular blocky structure; hard, friable, nonsticky and nonplastic; many fine roots; common fine pores; calcareous; moderately alkaline; clear smooth boundary.

C—9 to 60 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; weak fine subangular blocky structure; hard; friable, slightly sticky and slightly plastic; many fine roots; common fine pores; common thin strata of darker colored silty clay loam and lighter colored very fine sandy loam; calcareous; moderately alkaline.

The soils are slightly alkaline or moderately alkaline throughout the profile. The depth to bedding planes ranges from near the surface to 39 inches.

The A horizon is 3 to 15 inches thick and is brown, dark brown, or reddish brown.

The B horizon, where present, is reddish brown silt loam or silty clay loam. The clay content ranges from 20 to 35 percent.

The C horizon is stratified yellowish red or reddish brown silty clay loam, silt loam, or very fine sandy loam. Bedding planes are evident throughout the horizon.

Okay Series

The Okay series consists of very deep, well drained, moderately permeable, loamy soils on terraces along the Red River. These soils formed in loamy sediments. Slopes are 0 to 1 percent. Okay soils are fine-loamy, mixed, thermic Typic Argiudolls.

Typical pedon of Okay loam, 0 to 1 percent slopes; from the junction of Farm Road 1753 and Farm Road 1752 about 6 miles north of Savoy, 1.9 miles west on Farm Road 1753, 1.2 miles north on Farm Road 1897 to Ambrose (end of pavement), 0.6 mile east on county road, 100 feet north in cultivated field:

Ap—0 to 8 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium granular structure; slightly hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; common wormcasts; slightly acid; abrupt smooth boundary.

BA—8 to 14 inches; dark reddish brown (5YR 3/3) loam, reddish brown (5YR 4/3) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and nonplastic; common fine roots; common fine pores; common wormcasts; slightly acid; clear smooth boundary.

Bt1—14 to 24 inches; dark reddish brown (5YR 3/4) clay loam, reddish brown (5YR 4/4) dry; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; few wormcasts; many clay films on faces of peds; common bridging of sand grains; slightly acid; gradual smooth boundary.

Bt2—24 to 38 inches; yellowish red (5YR 4/6) clay loam, yellowish red (5YR 5/6) dry; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; common clay films on faces of peds; common bridging of sand grains; few iron-manganese concretions; slightly acid; gradual smooth boundary.

BC—38 to 65 inches; strong brown (7.5YR 5/6) loam, reddish yellow (7.5YR 6/6) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; few discontinuous clay films on faces of peds; few fine iron-manganese concretions; 2 to 4 percent, by volume, pockets of uncoated sand grains; neutral.

The solum is more than 60 inches thick. The mollic epipedon is 12 to 20 inches thick and may include part or all of the BA horizon. The content of clay in the control section ranges from 20 to 35 percent.

The A horizon is 8 to 16 inches thick. It is very dark grayish brown, dark brown, very dark brown, or dark reddish brown. Reaction is moderately acid or slightly acid.

The BA horizon, where present, is dark reddish brown, dark reddish gray, reddish brown, brown, or dark brown. The texture is loam or clay loam. Reaction is moderately acid or slightly acid.

The Bt horizon is dark reddish brown, dark red, reddish brown, red, yellowish red, brown, dark brown, or strong brown. The texture is clay loam or sandy clay loam. Reaction ranges from strongly acid to slightly acid.

The BC horizon is in shades of red or brown. The texture is fine sandy loam, loam, or sandy clay loam. Reaction ranges from strongly acid to neutral.

Oklared Series

The Oklared series consists of very deep, well drained, moderately rapidly permeable, loamy soils on flood plains along the Red River. These soils formed in calcareous, loamy alluvium. Slopes range from 0 to 2 percent. Oklared soils are coarse-loamy, mixed (calcareous), thermic Typic Udifluvents.

Typical pedon of Oklared fine sandy loam, in an area of Oklared-Kiomatia complex, occasionally flooded; north of Honey Grove on Farm Road 100 to

Riverby Ranch Headquarters, 2.4 miles north on field road, 100 feet east in cultivated field:

Ap—0 to 8 inches; reddish brown (5YR 4/4) fine sandy loam, reddish brown (5YR 5/4) dry; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine pores; calcareous; moderately alkaline; clear smooth boundary.

C—8 to 60 inches; reddish brown (5YR 5/4) fine sandy loam, light reddish brown (5YR 6/4) dry; massive; very friable, nonsticky and nonplastic; common thin strata of light reddish brown (5YR 6/4) loamy fine sand, silt loam, and very fine sandy loam; common fine roots, becoming less numerous with depth; common fine pores; evident bedding planes; calcareous; moderately alkaline.

Reaction is slightly alkaline or moderately alkaline.

The A horizon is 6 to 12 inches thick and is reddish brown, brown, strong brown, dark brown, dark reddish brown, strong brown, dark brown, or yellowish red.

The C horizon is reddish brown, yellowish red, reddish yellow, light reddish brown, red, or light red. It is dominantly fine sandy loam but has thin strata of loamy fine sand, silt loam, loam, or very fine sandy loam.

Porum Series

The Porum series consists of very deep, moderately well drained, slowly permeable, loamy soils on terraces along the Red River. These soils formed in loamy sediments. Slopes range from 2 to 12 percent. Porum soils are fine, mixed, thermic Glossaquic Paleudalfs.

Typical pedon of Porum loam, 2 to 5 percent slopes; from the junction of Texas Highway 78 and Farm Road 898 on the north side of Bonham, 4.2 miles east and north on Farm Road 898, 0.4 mile east on county road, and 200 feet south of road in native pasture:

A—0 to 5 inches; yellowish brown (10YR 5/4) loam, light brown (7.5YR 6/4) dry; weak fine granular structure; hard, friable, nonsticky and nonplastic; many fine roots; common fine pores; few wormcasts; strongly acid; clear wavy boundary.

Bt1—5 to 16 inches; yellowish red (5YR 4/6) clay loam, yellowish red (5YR 5/6) dry; moderate fine and medium subangular blocky structure; very hard, firm, sticky and plastic; common fine roots; few fine pores; few wormcasts; few clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2—16 to 30 inches; mottled red (2.5YR 5/6), dark yellowish brown (10YR 4/4), grayish brown (10YR 5/2), and gray (10YR 5/1) silty clay loam; moderate medium angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; common clay films on faces of peds; common pressure faces; few slickensides; very strongly acid; gradual smooth boundary.

Bt3—30 to 50 inches; mottled light gray (10YR 6/1), yellowish brown (10YR 5/4), and strong brown (7.5YR 5/6) silty clay loam; weak coarse angular blocky structure; very hard, firm, sticky and plastic; few fine roots; few very fine pores; few clay films on faces of peds; few vertical streaks of clean sand grains; strongly acid; gradual smooth boundary.

BC—50 to 80 inches; mottled strong brown (7.5YR 5/6), brown (7.5YR 5/4), dusky red (10R 3/4), and light gray (10YR 6/1) clay loam; weak coarse angular blocky structure; very hard, firm, sticky and plastic; few fine roots; few fine pores; few discontinuous clay films on faces of peds; about 5 percent, by volume, clean silt and sand grains; moderately acid.

The thickness of the solum ranges from 60 to more than 80 inches. The depth to mottles with chroma of 2 or less ranges from 16 to 30 inches. The content of clay in the control section ranges from about 35 to 45 percent.

The A horizon is 4 to 9 inches thick and is brown, dark grayish brown, grayish brown, or dark brown. Reaction ranges from very strongly acid to moderately acid. The E horizon, where present, is grayish brown, brown, yellowish brown, or pale brown.

The Bt horizon is red, reddish brown, or yellowish red and has few or common mottles of gray, light gray, light brownish gray, yellowish brown, light olive brown, light yellowish brown, or yellowish red, or it is mottled in these colors and has no matrix color. The amount of gray increases with depth. The texture is clay loam, silty clay loam, or silty clay. Reaction is very strongly acid or strongly acid.

The BC horizon is mottled in shades of gray, yellowish brown, red, or grayish brown. The texture is sandy clay loam, clay loam, or silty clay loam. Reaction ranges from moderately acid to slightly alkaline.

Raino Series

The Raino series consists of very deep, moderately well drained, very slowly permeable, loamy soils on terraces along the Red River. Slopes are 0 to 1 percent. Raino soils are fine-loamy over clayey, siliceous, thermic Aquic Glossudalfs.

Typical pedon of Raino very fine sandy loam, in an area of Derly-Raino complex, 0 to 1 percent slopes; from the junction of Farm Road 100 and Farm Road 273 in Monkstown, 2.8 miles north on Farm Road 100, 150 feet west in cropland:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) very fine sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular and subangular blocky structure; hard, very friable, nonsticky and nonplastic; many fine roots; common fine pores; moderately acid; clear smooth boundary.

BE—8 to 26 inches; brown (7.5YR 5/4) loam, reddish yellow (7.5YR 7/6) dry; moderate fine and medium subangular blocky structure; hard, very friable, slightly sticky and nonplastic; few fine roots; common fine pores; few iron-manganese concretions; few uncoated sand grains in the lower part; very strongly acid; diffuse irregular boundary.

Bt/E1—26 to 36 inches; light yellowish brown (10YR 6/4) loam, very pale brown (10YR 7/4) dry; common coarse distinct gray (10YR 5/1) and common coarse prominent yellowish red (5YR 4/6) and red (2.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; few iron-manganese concretions; few discontinuous clay films on faces of peds; about 20 percent pale brown (10YR 6/3) uncoated sand (E) as pockets and streaks 3 to 8 millimeters thick along faces of peds; very strongly acid; gradual wavy boundary.

Bt/E2—36 to 43 inches; yellowish brown (10YR 5/4) clay loam, light yellowish brown (10YR 6/4) dry; many coarse faint yellowish brown (10YR 5/6) and few medium prominent red (2.5YR 4/6) mottles; moderate medium subangular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few iron-manganese concretions; common light brownish gray (2.5Y 6/2); few clay films on faces of peds; about 15 percent light gray (10YR 7/2) uncoated sand and silt (E) surrounding peds and as pockets and streaks, mainly in the upper part of horizon; very strongly acid; gradual wavy boundary.

Btg1—43 to 68 inches; gray (10YR 5/1) clay loam, gray (10YR 6/1) dry; common coarse distinct yellowish brown (10YR 5/6) and few medium prominent red (2.5YR 4/6) mottles; moderate medium angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few very fine pores; few iron-manganese concretions; few pressure faces; common clay films on faces of peds; few thin streaks of uncoated sand; strongly acid; gradual wavy boundary.

Btg2—68 to 80 inches; mottled dark gray (10YR 4/1) and yellowish brown (10YR 5/6) clay loam; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few fine pores; few clay films on faces of peds; moderately acid.

The solum is more than 80 inches thick. The content of clay in the control section ranges from 25 to 35 percent.

The A horizon is 4 to 10 inches thick and is brown, grayish brown, dark grayish brown, or yellowish brown. Reaction ranges from strongly acid to slightly acid.

The BE horizon is brown, yellowish brown, strong brown, brownish yellow, reddish yellow, light yellowish brown, or pale brown with or without mottles of these colors and of grayish brown or light brownish gray. The texture is loam, fine sandy loam, or very fine sandy loam. Reaction is very strongly acid or strongly acid.

The Bt/E1 and Bt/E2 horizons are light yellowish brown and have few to many brownish, grayish, or reddish mottles, or the horizons are mottled gray, brown, light brownish gray, yellowish brown, yellowish red, red, or dark red. The E material is light gray, pale brown, or white uncoated sand and silt. The texture is loam, clay loam, or sandy clay loam. Reaction is very strongly acid or strongly acid.

The Btg1 and Btg2 horizons are yellowish brown, gray, or dark gray and have few to many grayish, brownish, reddish, or yellowish mottles. Reaction generally ranges from very strongly acid to moderately acid, but some pedons are slightly acid below a depth of 60 inches.

These soils are taxadjuncts to the Raino series because they do not have clay textures in the lower part of the argillic horizon. The use, management, and behavior of these soils are not affected by this difference.

Redlake Series

The Redlake series consists of very deep, moderately well drained, very slowly permeable, clayey soils on flood plains along the Red River. These soils formed in calcareous, clayey alluvium. Slopes are 0 to 1 percent. Redlake soils are fine, mixed, thermic Vertic Eutrochrepts.

Typical pedon of Redlake clay, rarely flooded; from the junction of Texas Highway 78 and Farm Road 274 about 11 miles north of Bonham, 4.0 miles west on Farm Road 274, 0.4 mile north on private road, 100 feet east in cultivated field:

Ap—0 to 6 inches; dark reddish brown (5YR 3/3) clay, reddish brown (5YR 4/3) dry; moderate fine and medium subangular blocky structure; very hard, firm, sticky and very plastic; many fine roots; many fine pores; few wormcasts; calcareous; moderately alkaline; clear smooth boundary.

Bw1—6 to 30 inches; dark reddish brown (5YR 3/4) clay, reddish brown (5YR 4/4) dry; moderate medium subangular blocky structure; very hard, firm, sticky and very plastic; few fine roots; few fine pores; common shiny faces of peds; few slickensides 1 to 2 centimeters across; calcareous; moderately alkaline; gradual wavy boundary.

Bw2—30 to 55 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few very fine pores; few shiny faces of peds; few slickensides 1 to 2 centimeters across; few wormcasts; calcareous; moderately alkaline clear wavy boundary.

2C—55 to 80 inches; yellowish red (5YR 5/6) clay loam; massive; firm, hard, sticky and plastic; stratified with few thin layers of friable silt loam; calcareous; moderately alkaline.

The solum is 30 to 60 inches thick. The soils are calcareous and slightly alkaline or moderately alkaline throughout the profile. The content of clay in the solum ranges from 40 to 60 percent.

The A horizon is 5 to 10 inches thick and is dark reddish brown or reddish brown.

The Bw horizon reddish brown, dark reddish brown, red, or dark red. The texture is clay or silty clay.

The 2C horizon, where present, is stratified brown, dark red, and yellowish red silt loam, clay loam, or clay. Bedding planes are common.

Severn Series

The Severn series consists of very deep, well drained, moderately rapidly permeable, loamy soils on flood plains along the Red River. These soils formed in calcareous, loamy alluvium. Slopes are 0 to 1 percent. Severn soils are coarse-silty, mixed (calcareous), thermic Typic Udifluvents.

Typical pedon of Severn silt loam, rarely flooded; north of Honey Grove on Farm Road 100 to the Riverby Ranch Headquarters, 1.5 miles north on private road, 0.1 mile east on private road, 200 feet north in cultivated field:

Ap—0 to 7 inches; reddish brown (5YR 4/4) silt loam, reddish brown (5YR 5/4) dry; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine pores; few wormcasts; common dark stains; calcareous; moderately alkaline; clear smooth boundary.

C1—7 to 24 inches; reddish brown (5YR 4/4) silt loam, reddish brown (5YR 5/4) dry; weak fine and medium granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; few fine pores; few wormcasts; many bedding planes; few thin strata of very fine sandy loam; calcareous; moderately alkaline; clear smooth boundary.

C2—24 to 60 inches; stratified, reddish brown (5YR 5/4) very fine sandy loam; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine pores; few wormcasts; few thin strata of light reddish brown fine sandy loam; common bedding planes; calcareous; moderately alkaline.

The soils are calcareous throughout the profile.

The A horizon is 5 to 16 inches thick. It is reddish brown or dark reddish brown. Reaction is slightly alkaline or moderately alkaline.

The C horizon is reddish brown, strong brown, yellowish red, or reddish yellow. The texture is stratified silt loam, loam, very fine sandy loam, or loamy very fine sand with thin strata of coarser or finer materials. This horizon has common or many bedding planes.

Stephen Series

The Stephen series consists of very shallow or shallow, well drained, moderately slowly permeable, clayey soils on uplands. These soils formed in chalk or in interbedded marl and chalk. Slopes range from 1 to 5 percent. Stephen soils are clayey, mixed, thermic, shallow Udorthentic Haplustolls.

Typical pedon of Stephen silty clay, 1 to 3 percent slopes; from the junction of U.S. Highway 82 and Farm Road 824 in Honey Grove, 0.4 mile south and 0.3 mile east on Farm Road 824, 1.1 miles east on county road, 100 feet south in cultivated field:

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common fine pores; few fine chalk fragments; calcareous; moderately alkaline; abrupt wavy boundary.

A—8 to 14 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; few fine pores; few fine

chalk fragments; calcareous; moderately alkaline; clear smooth boundary.

Cr—14 to 20 inches; white (10YR 8/2) and very pale brown (10YR 8/4), platy chalk that can be cut with a spade; few thin tongues of very dark grayish brown (10YR 4/2) silty clay in crevices between plates; calcareous; moderately alkaline.

The thickness of the solum and the depth to chalk range from 7 to 20 inches. The clay content ranges from 40 to 55 percent.

The A horizon is very dark gray, very dark brown, or very dark grayish brown. It has a few to 10 percent chalk fragments.

The A/C and C/A horizons, where present, are dark brown, brown, or dark grayish brown. They have a few to 35 percent chalk fragments. These horizons are as thick as 6 inches.

The Cr layer is white or very pale brown chalk, chalk interbedded with limy earth, or soft limestone and chalk than can be cut with a spade when moist.

Stephenville Series

The Stephenville series consists of moderately deep, well drained, moderately permeable, loamy soils on uplands. These soils formed in residuum weathered from sandstone. Slopes range from 1 to 3 percent. Stephenville soils are fine-loamy, siliceous, thermic Ultic Haplustalfs.

Typical pedon of Stephenville fine sandy loam, 1 to 3 percent slopes; from the junction of U.S. Highway 82 and Farm Road 1752 in Savoy, 3.7 miles south on Farm Road 1752, 0.1 mile west on county road, 100 feet north of road in rangeland:

A—0 to 7 inches; dark brown (7.5YR 3/2) fine sandy loam, dark brown (7.5YR 4/4) dry; weak fine granular structure; hard, very friable, nonsticky and nonplastic; many fine roots; common fine pores; slightly acid; clear smooth boundary.

Bt1—7 to 20 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; few fine distinct dark red (2.5YR 3/6) mottles; moderate fine subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; few clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—20 to 30 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; few fine distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; few clay films on faces of peds; strongly acid; clear wavy boundary.

Cr—30 to 40 inches; stratified, red (2.5YR 4/6) sandstone that can be cut with a spade, red (2.5YR 5/6) dry; few brownish yellow (10YR 6/6) streaks; extremely hard when dry; strongly acid.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The content of clay in the control section ranges from 20 to 35 percent.

The A horizon is 4 to 7 inches thick and is brown or dark brown. Reaction ranges from strongly acid to slightly acid.

The Bt horizon is reddish brown, red, yellowish red, or reddish yellow. The texture is sandy clay loam or fine sandy loam. Reaction ranges from very strongly acid to moderately acid.

The Cr layer is red, reddish yellow, or yellowish red sandstone that is extremely hard when dry and can be cut with a spade when moist.

Tinn Series

The Tinn series consists of very deep, moderately well drained, very slowly permeable, clayey soils on flood plains along streams. These soils formed in clayey alluvium. Slopes are 0 to 1 percent. Tinn soils are fine, smectitic, thermic Typic Hapluderts.

Typical pedon of Tinn clay, frequently flooded; from the junction of Texas Highway 78 and Farm Road 271 about 1.5 miles south of Bonham, 0.5 mile east on Farm Road 271, 200 feet south in pasture:

A—0 to 10 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; extremely hard, firm, very sticky and very plastic; few fine roots; few fine pores; few wormcasts; calcareous; moderately alkaline; clear wavy boundary.

Bss1—10 to 50 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate coarse angular blocky structure parting to moderate fine and medium angular blocky and subangular blocky; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; few wormcasts; many pressure faces; common intersecting slickensides; few fine iron-manganese concretions; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Bss2—50 to 80 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; few fine faint dark grayish brown mottles; moderate coarse angular blocky structure; extremely hard, very firm, very sticky and very

plastic; few fine roots; few very fine pores; many pressure faces; many intersecting slickensides; few fine iron-manganese concretions; few very fine concretions of calcium carbonate; calcareous; moderately alkaline.

The solum is more than 60 inches thick. The content of clay in the solum ranges from 40 to 60 percent. Intersecting slickensides are within 24 inches of the surface. When the soils are dry, cracks 1 to 2 inches wide extend to a depth of 20 inches. The soils are calcareous and are slightly alkaline or moderately alkaline throughout the profile.

The A horizon is black or very dark gray. It has no mottles or has few or common brownish, yellowish, or olive mottles below a depth of 20 inches.

The Bss horizon is dark gray, black, or very dark gray. It has few brownish, yellowish, or olive mottles. The texture is clay or silty clay.

Vertel Series

The Vertel series consists of moderately deep, well drained, very slowly permeable, clayey soils on uplands. These soils formed in weathered shale. Slopes range from 2 to 8 percent. Vertel soils are very-fine, smectitic, thermic Leptic Udic Haplusterts.

Typical pedon of Vertel clay, 2 to 5 percent slopes; from the junction of U.S. Highway 82 and Farm Road 1752 in Savoy, 2.3 miles north on Farm Road 1752, 100 feet west in rangeland:

A—0 to 9 inches; very dark grayish brown (2.5Y 3/2) clay, dark grayish brown (2.5Y 4/2) dry; strong medium subangular blocky structure; extremely hard, very firm, very sticky and very plastic; many fine roots; few fine pores; common wormcasts; neutral; gradual wavy boundary.

Bss1—9 to 20 inches; dark grayish brown (2.5Y 4/2) clay, grayish brown (2.5Y 5/2) dry; strong medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; few wormcasts; few slickensides; neutral; diffuse wavy boundary.

Bss2—20 to 36 inches; dark grayish brown (2.5Y 4/2) clay, grayish brown (2.5Y 5/2) dry; common fine distinct olive brown (2.5Y 4/4) mottles; strong medium angular blocky structure; extremely hard, very firm, sticky and very plastic; few fine roots; few very fine pores; common intersecting slickensides; slightly alkaline; clear wavy boundary.

Cr—36 to 55 inches; mottled dark gray (10YR 4/1) and yellowish brown (10YR 5/8), stratified, weathered shale; massive, with platy cleavage; extremely hard, very firm, slightly sticky and very plastic; few gypsum crystals between plates; moderately alkaline.

The solum is 24 to 40 inches thick. The clay content ranges from 60 to 76 percent. When the soils are dry, cracks $^1/_2$ inch to $1^1/_2$ inches wide extend from the surface into the upper part of the Cr layer.

The A horizon is 4 to 16 inches thick. It is dark grayish brown, very dark grayish brown, or olive. Reaction ranges from neutral to moderately alkaline.

The Bss horizon is dark grayish brown, grayish brown, light olive brown, olive gray, or olive. Reaction ranges from neutral to moderately alkaline.

The Cr layer is stratified dark gray, gray, olive, olive brown, or yellowish brown, weathered shale. Reaction ranges from moderately acid to moderately alkaline.

Waskom Series

The Waskom series consists of very deep, moderately well drained, moderately slowly permeable, loamy soils on stream terraces along the Red River. Slopes are 0 to 1 percent. Waskom soils are fine-loamy, mixed, thermic Aquic Argiudolls.

Typical pedon of Waskom silt loam, 0 to 1 percent slopes; from the junction of Farm Road 100 and Farm Road 273 in Monkstown, 0.4 mile north on Farm Road 100, 2.0 miles northwest on county road, 150 feet west in cultivated field:

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; common fine pores; slightly acid; clear smooth boundary.

A—8 to 16 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common fine roots; common fine pores; slightly acid; clear smooth boundary.

Bt1—16 to 24 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; few fine prominent reddish brown (5YR 4/4) and few fine faint dark yellowish brown mottles; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; few clay films on faces of peds; neutral; clear smooth boundary.

Bt2—24 to 36 inches; dark yellowish brown (10YR 3/4) clay loam, yellowish brown (10YR 5/4) dry; few fine prominent reddish brown (5YR 4/4) mottles; moderate fine subangular blocky structure; hard,

friable, sticky and plastic; few fine roots; few fine pores; few discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt3—36 to 60 inches; mottled brown (10YR 5/3), grayish brown (10YR 5/2), and yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure, very hard, firm, sticky and plastic; few fine roots; few fine pores; thin clay films on faces of peds; neutral; gradual smooth boundary.

BC—60 to 80 inches; mottled yellowish brown (10YR 5/4, 5/6) and grayish brown (2.5Y 5/2) clay loam; weak coarse subangular blocky structure, very hard, firm, sticky and plastic; few fine roots; few very fine pores; few clay films on faces of peds; few iron-manganese concretions; slightly alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The mollic epipedon is 20 to 40 inches thick and includes part of the argillic horizon. The content of clay in the control section ranges from 18 to 30 percent.

The A horizon is 10 to 19 inches thick. It is dark brown, very dark brown, or very dark grayish brown. It has no mottles or has few reddish or brownish mottles. Reaction ranges from moderately acid to neutral.

The Bt1 horizon is dark brown, very dark brown, or very dark grayish brown. It has mottles in shades of red, brown, or yellow in some pedons. The texture is loam, sandy clay loam, or clay loam. Reaction is slightly acid or neutral.

The Bt2, Bt3, and BC horizons are mottled, mainly in shades of brown, with or without fine or medium reddish mottles. Reaction ranges from slightly acid to slightly alkaline.

Whakana Series

The Whakana series consists of very deep, well drained, moderately permeable, loamy soils on terraces along the Red River. These soils formed in loamy sediments. Slopes range from 1 to 12 percent. Whakana soils are fine-loamy, mixed, thermic Glossic Paleudalfs.

Typical pedon of Whakana very fine sandy loam, 1 to 3 percent slopes; from the crossroads of Farm Road 1396 and a county road in Lamasco, 2.9 miles north and west on county road, and 0.4 mile north on private road, 200 feet west of road in improved pasture:

A—0 to 14 inches; brown (7.5YR 5/4) very fine sandy loam, light brown (7.5YR 6/4) dry; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; common fine pores; few fine siliceous pebbles; neutral; clear smooth boundary.

Bt—14 to 32 inches; red (2.5YR 4/6) sandy clay loam, red (2.5YR 5/6) dry; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; common fine roots; common fine pores; discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt/E1—32 to 65 inches; red (2.5YR 4/6) sandy clay loam, red (2.5YR 5/6) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and slightly plastic; few fine roots; few fine pores; few discontinuous clay films on faces of peds; about 5 percent white (10YR 8/1) tongues and streaks of loamy sand 2 to 4 millimeters wide on faces of peds; moderately acid; gradual smooth boundary.

Bt/E2—65 to 80 inches; red (2.5R 4/8) sandy clay loam, red (2.5R 5/8) dry; weak coarse prismatic structure parting to weak medium subangular blocky; hard, firm, slightly sticky and slightly plastic; few fine roots; few fine pores; few discontinuous clay films on faces of peds; about 10 percent white (10YR 8/1) tongues and streaks of loamy sand; moderately acid.

The thickness of the solum ranges from 60 to more than 72 inches. The content of clay in the control section ranges from 18 to 35 percent.

The A horizon is 5 to 16 inches thick. It is dark brown, very dark grayish brown, dark grayish brown, or brown. Reaction ranges from moderately acid to neutral.

The E horizon, where present, is one or two units higher in value than the A horizon.

The Bt horizon is yellowish red, red, reddish brown, dark reddish brown, or dark red. Few or common mottles of these colors are in most pedons. The texture is loam, sandy clay loam, or clay loam. Reaction ranges from strongly acid to slightly acid.

The Bt/E horizon is reddish brown, red, or yellowish red. The texture is loam or sandy clay loam. Reaction is very strongly acid to moderately acid. Silt coatings, pockets of loamy sand or sandy loam, and tongues of light gray, gray, or white loamy sand or sandy loam (E) make up 5 to 30 percent of the horizon.

Whitesboro Series

The Whitesboro series consists of very deep, moderately well drained, moderately permeable, loamy soils on flood plains along local streams. These soils formed in loamy alluvium. Slopes are 0 to 1 percent. Whitesboro soils are fine-loamy, mixed, thermic Cumulic Haplustolls.

Typical pedon of Whitesboro loam, frequently flooded; from the junction of Farm Road 1752 and Farm Road 1753 about 6 miles north of Savoy, 0.6 mile east on Farm Road 1753, 200 feet north in rangeland:

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; hard, firm, slightly sticky and nonplastic; many fine roots; common fine pores; neutral, gradual smooth boundary.

A2—8 to 36 inches; dark brown (10YR 3/3) clay loam, dark brown (10YR 4/3) dry; moderate medium subangular blocky structure; hard, firm, slightly sticky and plastic; many fine roots; common fine pores; neutral; gradual smooth boundary.

Bw—36 to 60 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; few fine prominent yellowish red (5YR 4/6) mottles; moderate coarse subangular blocky structure; very hard, very firm, sticky and plastic; few fine roots; few fine pores; neutral.

The solum is more than 60 inches thick. The mollic epipedon is 20 to about 60 inches thick. The content of clay in the control section ranges from 20 to 35 percent.

The A horizon is dark brown, very dark brown, very dark grayish brown, or very dark gray. Reaction is slightly acid or neutral.

The Bw horizon, where present, is dark brown, dark grayish brown, very dark grayish brown, dark gray, or very dark gray. It is mottled in shades of brown, gray, red, or yellow in the lower part. The texture is clay loam, sandy clay loam, or loam. Reaction ranges from slightly acid to slightly alkaline.

Whitewright Series

The Whitewright series consists of shallow, well drained, moderately permeable, loamy soils on uplands. These soils formed in chalk or in chalk interbedded with marl. Slopes range from 3 to 12 percent. Whitewright soils are loamy, carbonatic, thermic, shallow Typic Ustochrepts.

Typical pedon of Whitewright silty clay loam, in an area of Whitewright-Howe complex, 5 to 12 percent slopes, eroded; from the junction of U.S. Highway 69 and Farm Road 896 on the north side of Leonard, 3.0 miles northwest on U.S. Highway 69, 0.7 mile north on county road, 0.1 mile east and 0.7 mile north on county road, 600 feet east in rangeland:

A—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; slightly hard, firm, slightly sticky and plastic; many fine roots; common fine pores; few wormcasts; calcareous; moderately alkaline; clear smooth boundary.

Bk—7 to 17 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; moderate fine subangular blocky structure; slightly hard, firm, slightly sticky and plastic; common fine roots; common fine pores; few wormcasts; 10 percent chalk fragments; few films and threads of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—17 to 30 inches; gray (10YR 5/1), platy chalk, white (10YR 8/1) dry; becoming more massive and harder with depth.

The thickness of the solum ranges from 10 to 20 inches. The soils are calcareous, and the calcium carbonate equivalent ranges from 40 to more than 80 percent.

The A horizon is 6 to 14 inches thick. It is dark grayish brown, grayish brown, light grayish brown, dark brown, brown, or pale brown. It has as much as 15 percent chalk fragments in some pedons.

The Bk horizon is dark brown, brown, light brownish gray, pale brown, light yellowish brown, light gray, or very pale brown. The texture is silty clay loam or clay loam. This horizon has a few to 35 percent, by volume, weakly cemented to strongly cemented chalk fragments.

The Cr layer is white or gray, platy chalk that can be cut with a spade when moist and generally becomes less fractured, more massive, and harder with depth.

Wilson Series

The Wilson series consists of very deep, moderately well drained, very slowly permeable, loamy soils on terrace remnants associated with uplands. These soils formed in clayey sediments. Slopes are 0 to 1 percent. Wilson soils are fine, smectitic, thermic Oxyaquic Vertic Haplustalfs.

Typical pedon of Wilson silt loam, 0 to 1 percent slopes; from the junction of Texas Highway 121 and Farm Road 1629 about 5 miles southwest of Bonham, 0.1 mile south on Texas Highway 121, 200 feet east in cultivated field:

A—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; massive; very hard, friable, slightly sticky and nonplastic; many fine roots; common fine pores; slightly acid; clear wavy boundary.

Btg1—8 to 24 inches; very dark gray (10YR 3/1) silty

clay, dark gray (10YR 4/1) dry; moderate medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; continuous clay films on faces of peds; few iron-manganese concretions; slightly acid; gradual wavy boundary.

Btg2—24 to 40 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; moderate medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few very fine pores; continuous clay films on faces of peds; few salt crystals; few iron-manganese concretions; common cracks, 2 to 3 centimeters wide, filled with very dark gray (10YR 3/1) silt loam; slightly acid; diffuse wavy boundary.

Btg3—40 to 55 inches; gray (10YR 5/1) silty clay loam, light gray (10YR 6/1) dry; few fine distinct brownish yellow (10YR 6/6) mottles; weak coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine roots; few very fine pores; discontinuous clay films on faces of peds; few salt crystals; few fine iron-manganese concretions; moderately alkaline; gradual smooth boundary.

BCg—55 to 80 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; common fine distinct brownish yellow (10YR 6/6) mottles; extremely hard, very firm, very sticky and very plastic; few very fine roots; few very fine pores; few clay films on faces of peds; few fine iron-manganese concretions; few fine concretions of calcium carbonate; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The content of clay in the control section ranges from 35 to 45 percent. When dry, the Bt horizon has cracks 2 to 5 centimeters wide to a depth of 2 to 4 feet.

The A horizon is 5 to 10 inches thick. It is very dark grayish brown, dark grayish brown, or very dark gray. Reaction is slightly acid or neutral.

The Btg1 horizon is black, very dark gray, or dark gray. In some pedons it has few or common brownish or yellowish mottles. The texture is clay, silty clay, silty clay loam, or clay loam. Reaction ranges from slightly acid to slightly alkaline.

The Btg2, Btg3, and BCg horizons are dark gray, dark grayish brown, gray, light gray, grayish brown, or olive gray. They have few or common mottles in shades of brown, olive, or yellow. The texture is clay loam, silty clay loam, silty clay, or clay. Reaction ranges from slightly acid to moderately alkaline.

The C horizon, where present, is mottled light brownish gray, gray, grayish brown, brownish yellow, or olive gray. The texture is clay, silty clay, silty clay loam, or clay loam. Reaction is slightly alkaline or moderately alkaline.

Formation of the Soils

This section relates the factors of soil formation to the soils in Fannin County. It also describes the surface geology in the county.

Factors of Soil Formation

Soil forms through processes that act on geologic material. The properties of the soil result from the kind of parent material and from additions, removals, transfers, and translocations caused by climate, plant and animal life, relief, and time. Also important are the cultural environment and patterns of land use.

The characteristics of a soil at any given point are determined by the physical and mineral composition of the parent material; the climate during and after accumulation of the parent material; the plant and animal life on and in the soil; relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material. All five of these factors are important in the formation of any soil, but the influence of each varies from place to place.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineral composition of the soil. The soils in Fannin County formed in several kinds of parent material. These materials are described under the heading “Surface Geology.”

Climate

The climate of Fannin County is warm and humid; the summer months are hot. Rainfall, evaporation, and temperature are the main climatic factors influencing soil formation. High temperatures and adequate rainfall favor soil development by supporting relatively high rates of microbial activity and chemical and physical processes within the soil. These high rates have resulted in the formation of very deep soils in the county.

Plant and Animal Life

The vegetation under which a soil forms influences such soil properties as color, structure, reaction, and content and distribution of organic matter. Vegetation extracts water from the soil, recycles nutrients, and adds organic matter to the soil. Gases derived from root respiration combine with water to form acids that influence the weathering of minerals. Because of a lower content of organic matter, soils that formed under forest vegetation generally are lighter in color than soils that formed under grasses.

Bacteria, fungi, and many other micro-organisms decompose organic matter and release nutrients to growing plants. They influence the formation of soil structure. Such soil properties as drainage, temperature, and reaction influence the type of micro-organisms that live in the soil. Fungi generally are more active in the more acid soils, whereas bacteria are more active in the less acid, more alkaline soils.

Earthworms, insects, and small burrowing animals mix the soil and create small channels that aid in soil aeration and water movement. Earthworms help to incorporate crop residue or other organic matter into the soil. The organic matter improves tilth. In areas that are well populated with earthworms, the leaf litter that accumulates on the soil in the fall generally is incorporated into the soil by the following spring. If the earthworm population is low, part of the leaf fall can remain on the soil surface for several years.

Human activity can significantly influence soil formation. The clearing of native forests followed by continuous farming may drastically change activities within the soil. Cultivation generally accelerates erosion on sloping soils, affects soil structure and compaction, and lowers the content of organic matter. Drainage of wet soils changes soil formation. Fertilizers, lime, and pesticides also affect soil formation. Development of land for urban uses or for mining significantly influences soil formation.

Relief

Relief influences soil formation through its effect on drainage, runoff, and the depth of soil moisture penetration.

Relief in Fannin County is nearly level to moderately steep. The nearly level areas consist of flood plains and stream terraces. The more sloping areas are mostly on the higher parts of the landscape.

If other factors are equal, the degree of soil profile

development depends upon the amount, depth, and penetration of soil moisture. The more often a soil passes through a wetting and drying cycle, the greater and more distinct the soil development.

Soils in nearly level areas tend to have marked differences in soil development. Nearly level soils that are poorly drained and that remain saturated much of the time generally do not have pronounced horizons. Nearly level soils that are well drained generally are distinctly developed to a depth of more than 60 inches.

Most of the gently sloping and moderately sloping soils in the county are developed to a depth of more than 60 inches. As the slope increases above 8 percent, the depth of water penetration generally decreases. Since much of the water is removed by runoff, the solum of the more sloping soils tends to be thinner than the solum of the less sloping soils.

Time

A great length of time is required for the formation of soils with distinct horizons. Differences in the length of time that the parent material has been in place are commonly reflected in the degree of development of soil horizons. Young soils show very little edidence of horizon development. Old soils generally have well expressed horizons.

Oklared and Severn are young soils on flood plains where sediment is continuously added. They show little evidence of horizon development and retain most of the characteristics of their loamy parent material.

Advanced stages of development are evident in many of the soils in the county. Crockett soils, for example, formed over a long period of time. They have distinct horizons that bear little resemblance to the parent material.

Surface Geology

Millard D. Brent, Grayson County College, Denison, Texas, and Donald H. Lokke, Richland College, Dallas, Texas, helped prepare this section.

Throughout Fannin County there is a close correspondence between surface geology and soils (Barnes, 1967). The soils formed in Cretaceous bedrock residuum, Pleistocene fluvial sediment, and Holocene alluvium. Cretaceous bedrock outcrops include sandstone, clay, marl, chalk, and limestone (Adkins, 1932, and Barnes, 1967). Pleistocene terraces lie across much of the northern part of the county. The terraces are underlain by clastic sediments deposited by the Red River. The sediments were derived from a source area extending to the Texas Panhandle and northeastern New Mexico (Frye and Leonard, 1963). Holocene alluvium along local streams consists of sediment derived from local bedrock and reworked Pleistocene deposits (Lokke and Brent, 1966b).

The Preston Anticline, the major geologic structure in the county, is a broad arch that trends northwest-southeast and plunges southeastward. It enters the county in the northwest and continues through the western part of the county (Bullard, 1931). Bedrock, stream channels, and soil types are deflected southeastward in broad curves as they pass over the axis of the anticline.

Fannin County lies within the drainage basins of the Red River and the East Fork of the Trinity River. The divide between the two basins lies in the extreme southwest part of the county (the Leonard-Trenton area) and trends northwest-southeast. Stream channel patterns and characteristics are inextricably influenced by geologic structure and lithology. The drainage divide and stream channels in the eastern parts of the county are deflected southward as they pass over the Preston Anticline (Barnes, 1967). The southeastern part of the county is in the drainage basin of the North Sulphur River, a tributary of the Red River. The North Sulphur River originates near the axis of the Preston Anticline and flows eastward, paralleling the generally east-northeast strike of south-southeast dipping Cretaceous bedrock.

The streams in the county generally flow in channels cut through alluvium deposited by larger streams during Pleistocene and Holocene times. Alluvial deposits along Bois d'Arc Creek, the North Sulphur River, and other Red River tributaries and along tributaries of the East Fork of the Trinity River reflect the Cretaceous bedrock from which they were derived. The North Sulphur River has cut through Pleistocene fluvial deposits consisting of a surface veneer of Wisconsinan-age sediments and the underlying sediments of Kansan age (Frye and Leonard, 1963). Adjacent to the channel, the stream has cut into Holocene alluvium.

Cretaceous Strata

Cretaceous bedrock in Fannin County formed in shallow seas that extended inland from the Gulf of Mexico. The outcrops in the county are Upper Cretaceous in age. The oldest Cretaceous strata occur as the Dexter member of the Woodbine Formation, which crops out in northwestern Fannin County. The youngest strata occur as Marlbrook Marl, which crops out in a small area in the extreme southeast part of the county (Barnes, 1967). All strata, originally flat lying, dip generally south-southeast at about 30 to 35 feet per mile and strike east-northeast (Lokke and Brent, 1966a). Outcrop patterns, dip, and

strike are locally influenced in the western part of the county by folding associated with the Preston Anticline.

Woodbine Formation

The Woodbine Formation crops out in the northwestern part of the county. It is approximately 625 feet thick and includes, from oldest to youngest, the Dexter, Red Branch, Lewisville, and Templeton members. The Dexter member is a ferruginous to siliceous sandstone restricted to a narrow east-west belt which is unconformably overlain to the north by Pleistocene fluvial deposits. The Red Branch and Lewisville members crop out south and east of the Dexter member. They consist of sandstone with associated silt and shale. The Dexter, Red Branch, and Lewisville members weather to red and yellow colors on surface exposures (Adkins, 1932). The Templeton member is the youngest stratum in the Woodbine Formation. It is essentially a sandy shale at its outcrop approximately 2 miles north of Savoy. The Woodbine Formation outcrop is characterized by hilly topography and post oak vegetation. The Dexter, Red Branch, and Lewisville members are overlain by soils of the Crosstell-Birome general soil map unit. The Templeton member is overlain by soils of the Normangee-Wilson-Bonham general soil map unit.

Eagle Ford Formation

The Eagle Ford Formation lies south and east of the Woodbine Formation. The lowermost part of the Eagle Ford Formation is an undifferentiated shale 300 to 400 feet thick (Adkins, 1932). It forms a gently rolling topography which is covered primarily by grassland vegetation. The shale is bituminous, has calcium carbonate concretions and septaria, and is well exposed at Sowell’s Bluff, along the Red River.

The Bells Sand member is stratigraphically above the undifferentiated shale. It is 46.6 feet thick at the type locality and thickens eastward. It can be traced at the surface from the Bells community, in northeastern Grayson County, to the Ector community, northeastward to the Ravenna community, and thence eastward, except where overlain by Pleistocene fluvial deposits, to north of Lake Crockett. Near Lake Crockett, the Bells Sand member is exposed in a bluff at Bois d’Arc Springs (McNulty, 1966, and McNulty et al., 1981). Bells Sand is a locally cross-bedded, friable quartz sandstone that weathers to a gray-brown color. A sandhill topography has developed on the Bells Sand from the Savoy community westward.

The 10-inch-thick Fish Bed Conglomerate is at the top of the Bells Sand (Taff and Leverett, 1893). In Fannin County the conglomerate consists of coarse, calcareous sand, quartz pebbles, chert, and shark teeth. It is exposed about 0.5 mile east of Ector, about 3 miles south of Ravenna, and at Lake Crockett.

The Maribel member is above the Fish Bed Conglomerate. It is a light greenish, sandy, calcareous shale that crops out in a narrow band north of Ector Chalk. It becomes increasingly sandy eastward in Fannin County, where it has sandstone beds. The Maribel member crops out south of Ravenna, where it lies in contact above the Fish Bed Conglomerate and below the Ector Chalk (McNulty, 1966).

Soils of the Normangee-Wilson-Bonham general soil map unit have developed on the Eagle Ford Formation in western Fannin County. In areas of the Whakana-Porum-Freestone general soil map unit in eastern Fannin County, erosion has dissected Pleistocene fluvial deposits and exposed the Eagle Ford Formation.

Austin Group

The oldest chalk strata in the county occur as the Ector Chalk. This chalk is 50 feet thick at its type locality approximately three-quarters of a mile east of the town of Ector (Hill, 1901). The outcrop is approximately 2 miles wide south of Ector and can be traced from Ector northeast to the Ridings community and eastward to Lake Crockett. It thins eastward and is only a few feet wide at Ridings (Lokke and Brent, 1966a). Between Ridings and Lake Crockett, the Ector Chalk is overlain by Pleistocene fluvial deposits. West of the type locality, it thickens and merges with the undivided Austin Chalk in Grayson County. South of the towns of Ector and Savoy, the Ector Chalk outcrop is approximately 1.5 miles wide, has a gently rolling topography, and corresponds to the Fairlie-Dalco general soil map unit.

Bonham Marl lies stratigraphically above and crops out south and east of the Ector Chalk. The marl has a maximum thickness of approximately 400 feet. It was named for exposures north of the city of Bonham. It is a waxy clay which weathers to yellowish green at its type locality (Stephenson, 1927). It also contains silt and is somewhat calcareous. Westward, it becomes increasingly calcareous until it merges with the undivided Austin Chalk in Grayson County. Eastward, it becomes less calcareous and increasingly marly (Hill, 1901). Northeast of the city of Bonham, it is overlain unconformably by Pleistocene fluvial deposits. The surface of Bonham Marl is a gently rolling plain. The Bonham Marl outcrop west of Bois d’Arc Creek corresponds to the Normangee-Wilson-Bonham general soil map unit. Northeast of Lake Bonham, soils of the Whakana-Porum-Freestone general soil map unit developed on the outcrop. Ivanhoe soils

developed on the outcrop approximately 1.5 miles east of Lake Crockett.

The Blossom Formation overlies and crops out south of the Bonham Formation in a zone ranging from 0.25 mile to 2.75 miles in width. The formation thins westward and merges with the Bonham Formation at Bois d'Arc Creek, east of the city of Bonham. The Blossom Formation is a calcareous, ferruginous sand with thin beds of clay. It weathers to brown and red colors. Septaria, concretions, and megafossils are common. The formation thickens and the outcrop widens eastward (Lokke and Brent, 1988). The surface of the Blossom Formation outcrop is a gently rolling plain with broad divides between stream valleys. The surface of the formation is overlain by soils of the Ellis-Crockett general soil map unit eastward to approximately Allens Point. East of Allens Point, it is overlain by Crockett soils.

Brownstown Marl lies south of the Blossom Formation. It is a poorly bedded, calcareous marl and clay with glauconite at its base (Adkins, 1932, and Hill, 1901). The thickness ranges from 80 to 175 feet. *Exogyra ponderosa* and *Inoceramus* fossils are common. Weathered outcrop colors are yellow to brown; the more calcareous beds are lighter in color. The outcrop is 1.5 to 4.0 miles wide. Westward, it merges with the Bonham Formation at Bois d'Arc Creek. Eastward through the county, it thickens and the width of the outcrop increases. The formation is highly susceptible to water erosion and mass wasting. Its outcrop is dissected by stream channels. Only a few flat interfluve surfaces remain. Ferris soils are mapped over the outcrop west of the Honey Grove and Allens Point communities. Eastward, Crockett soils occur on the outcrop.

Gober Chalk lies south of the Brownstown Marl and the Bonham Marl. Its outcrop is the most extensive chalk formation in the county. The maximum width of the outcrop, approximately 9.5 miles, is in western Fannin County. The width of the outcrop and the thickness of the formation decrease eastward (Lokke and Brent, 1988). Gober Chalk merges with the undivided Austin Chalk in eastern Grayson County (Adkins, 1932, and Stephenson, 1927).

Gober Chalk consists primarily of chalk with interbedded calcareous marl. East of the town of Honey Grove, the lower part of the Gober Chalk is distinctly marly and grades into Brownstown Marl in Lamar County. The chalk weathers to white and is exposed in creeks, in road cuts, and on hill slopes.

The Roxton Limestone member is a calcareous, glauconitic, fossiliferous limestone bed making up the upper 10 feet of the Gober Chalk (Templin et al., 1946). The surface of the Roxton Limestone is brown to tan and locally is red where glauconite has weathered to oxidized iron.

Throughout the Gober Chalk outcrop, terraces at the higher elevations underlain by chalk gravel are common along major stream valleys. Holocene clastics under these terraces generally weather to a tan color. Topographically, the Gober Chalk forms a plain which is sporadically dissected by streams. It forms the divide between the Red River and the East Fork of the Trinity River and the divide between the North Sulphur River and Bois d'Arc Creek. Elevation and the extent of stream dissection increase westward toward the Preston Anticline area, where the topography is distinctly hilly. The Roxton Limestone member and the upper portion of the Gober Chalk correspond to areas of gentle slopes (less than 3 percent) and are overlain by soils of the Fairlie-Dalco general soil map unit. Soils of the Whitewright-Howe general soil map unit developed on the steeper slopes (up to 12 percent) in areas of the stream-dissected lower portion of the Gober Chalk. Northeast of Honey Grove, soils of the Houston Black-Leson general soil map unit developed in the more marly eastern portion of the Gober Chalk.

Ozan Formation

The Ozan Formation lies south of the Gober Chalk. Its outcrop trends from southwest to northeast and thence eastward across the southern portion of the county. The Ozan Formation is approximately 425 feet thick and is a poorly bedded, calcareous clay with associated fine grained sand and silt (Barnes, 1967). The bedrock is compact, highly jointed, blocky, and laminated. The lower portion of the formation is fossiliferous. The formation weathers to a light brownish gray color. The Ozan Formation is highly erodible. It is subject to mass wasting and is dissected by stream erosion.

Ferris soils developed on the Ozan Formation south of the North Sulphur River. Steep-gradient, obsequent streams in this area have developed a dissected topography with steep slopes. North of the North Sulphur River, resequent streams have developed on the dip slope of the Ozan Formation and slopes are subdued. Soils of the Normangee-Wilson-Bonham general soil map unit occur in this vicinity. Areas of the Houston Black-Leson general soil map unit are north and west of the North Sulphur River. Crockett soils are in the more sandy portions of the Ozan Formation outcrop.

Wolfe City Formation

The Wolfe City Formation crops out in southeastern Fannin County, south of the Ozan Formation. The

outcrop belt is approximately 2 miles wide. The formation ranges from 75 to 120 feet in thickness. It consists of sand, sandy marl, calcareous sandstone, and sandstone concretions. The middle part of the formation is a fossiliferous, calcareous sandstone. The lower part is a dark gray, calcareous mudstone. The formation weathers to a yellowish gray to gray color, and the topography on the outcrop is a rolling plain with broad divides between stream channels. Crockett soils are associated with this formation.

Pecan Gap Chalk

Pecan Gap Chalk crops out south of the Wolfe City Formation in extreme southeast Fannin County. It is about 120 feet thick and grades upward from a bluish, massive chalk in the lower 10 feet to an argillaceous, sandy chalk in the upper part. The chalk is distinctly bedded and weathers to a gray to white color. The lower 2 to 3 feet has phosphatic casts of fossil mollusks. In Fannin County the outcrop is about 1 mile wide. Typically, the topographic expression of the outcrop is a gently rolling plain with broad divides between stream channels (McNulty et al., 1981). Soils of the Fairlie-Dalco general soil map unit developed on the outcrop of the lower part of the Pecan Gap Chalk. Soils of the Houston Black-Leson general soil map unit developed on the upper part of the chalk.

Marlbrook Marl

The youngest Cretaceous-age formation in Fannin County is Marlbrook Marl (Barnes, 1967). It crops out in a small area in the southeast corner of the county, where only the lower few feet of the formation are evident. In Fannin County the outcrop is approximately 0.75 mile wide. The formation is a calcareous clay and silt. It weathers from light gray to white and forms a gently rolling topography (Adkins, 1932). The soils on the outcrop are in the Houston Black-Leson general soil map unit.

Pleistocene and Holocene Deposition

Pleistocene terraces and related fluvial sediment, deposited by the Red River during four extensive Pleistocene depositional episodes, are in northern Fannin County (Barnes, 1967, and Frye and Leonard, 1963). The Red River drainage basin extends westward to the High Plains of Texas and eastern New Mexico. Consequently, sediments deposited by the Red River reflect a more diverse geological environment than sediments deposited by streams that developed near or within the county. Pleistocene Red River sediment generally consists of gravel at the base and grades upward to sand and silt (Frye and Leonard, 1963). Pleistocene terraces and fluvial sediment are over the Cretaceous-age Woodbine Formation, Eagle Ford Formation, Ector Chalk, and Bonham Marl.

The terraces are flat, except where they have been locally dissected by encroaching streams. The banks and channels of streams generally are masked by alluvium and colluvium derived from fluvial sediment. Locally, flat topography on pre-Wisconsinan terraces is interrupted by pimple mounds. The mounds are irregular to elliptical bodies of sand which seldom exceed 5 feet in height and are separated by intermound areas. Mound and intermound areas are made up of clastic sediment derived from fluvial deposition. It is hypothesized that the mounds formed as a result of wind scour and subsequent deposition around clumps of vegetation. Wind erosion and deposition occurred in a period of relatively arid climate during the Bradyan interval of the Pleistocene epoch (Frye and Leonard, 1963).

Chalk gravel deposits have been identified on the outcrop of the Gober Chalk along portions of Bois d’Arc Creek and its tributaries in southern Fannin County. These fluvial gravel deposits reach a thickness of 14 feet and merge imperceptibly with uplands. Terraces in areas of these gravel deposits are 30 to 70 feet above the present elevations of the flood plains. The chalk pebbles are overlain by approximately 8 to 12 inches of olive gray soil (Lokke and Brent, 1966b). The terraces and underlying sediment adjacent to the stream channels are of Holocene age.

Tinn soils are mapped on Holocene flood plains in the vicinity of Bonham and in an area of flood-plain alluvium along the North Sulphur River. Frioton soils are mapped on flood plains south of Bonham and on flood plains along Davis, Sloans, and Honey Grove Creeks.

Red River Terraces

Most of the Hardeman Terrace lies at an elevation of more than 580 feet and within a rectangular area outlined by Lake Bonham, Carson, Telephone, and Lake Fannin. The terrace covers interfluve areas of Coffee Mill Creek, south-flowing tributaries of Bois d’Arc Creek, and related stream channels. Local stream channels have cut through the terrace and fluvial sediment into the underlying Cretaceous bedrock. The terrace is Kansan in age. The underlying fluvial sediment consists of basal gravel grading upward to sand, clay, and silt. The maximum thickness is 30 feet, and the major constituents, clay and silt, weather to a tan to yellow color (Frye and Leonard, 1963). The southern part of the terrace and fluvial sediment is weathered to red and tan colors on the surface and is underlain by Bonham Marl. To the north,

the terrace is underlain by Bells Sand, Maribel Shale, and the undifferentiated shale of the Eagle Ford Formation. The interface between material derived from weathered bedrock and overlying fluvial sediment is gradational in areas where the underlying bedrock is either Bells Sand or Bonham Marl. Contact between the Eagle Ford Formation shales and fluvial sediment is less gradational and thus more easily recognized. In the area near the entrance to Lake Fannin, the sediment from weathered bedrock material and fluvial sediment lies over an outlier of Ector Chalk and, where exposed, the contact is easily distinguished (Lokke and Brent, 1966a). The main area of the terrace corresponds to the Ivanhoe general soil map unit and parts of the Whakana-Porum-Freestone general soil map unit. Hicota soils developed on pimple mounds.

Hardeman Terrace outliers occur at an elevation of approximately 588 feet in northwestern Fannin County. The outliers are along the upper tributary interfluves of Caney and Brushy Creeks. West of Brushy Creek, the terrace overlies the sandy Red Branch member of the Woodbine Formation. Between Caney Creek and Brushy Creek, the formation overlies the shaly Templeton, sandy Lewisville, and sandy Red Branch members of the Woodbine Formation. East of Caney Creek, the terrace overlies shaly members of the Eagle Ford Group.

Areas of the Crosstell-Birome general soil map unit are on the Hardeman Terrace west of Brushy Creek. The Crosstell-Birome and Wilson-Bastrop general soil map units occur between Caney Creek and Brushy Creek. East of Caney Creek, soils of the Normangee-Wilson-Bonham and Crosstell-Birome general soil map units overlie the terrace.

An unnamed terrace of Illinoian age lies below the elevation of the Kansan-age Hardeman Terrace. It occurs in three discontinuous areas in northern Fannin County and lies approximately 60 feet above the flood plain along the Red River. The largest area of the terrace lies 1.5 miles north of the community of Telephone; a small area of the terrace lies approximately 0.5 mile south of Lake Fannin; and a third, larger area of the terrace lies north of Ridings and Ravenna. Surface topography is flat, except where the terrace is dissected by stream channel erosion or interrupted by pimple mounds.

Fluvial sediments under the terrace consist of approximately 30 feet of gravel, sand, and silt. These sediments are similar to those under the Hardeman Terrace; however, the younger Illinoian-age sediments contain less silt and are redder than those under the Hardeman Terrace. North of the community of Telephone and south of Lake Fannin, the terraces and fluvial sediment are underlain by Eagle Ford shale. The southern portion of the terrace, north of Ridings and Ravenna, lies over the Bells Sand member of the Eagle Ford Formation. The northern portion of the terrace, however, lies over shale of the Eagle Ford Formation.

Portions of the terrace north of Telephone and south of Lake Fannin correspond to the Karma-Derly general soil map unit. The area north of Ravenna and Ridings corresponds to the Ivanhoe and Crosstell-Birome general soil map units.

The Ambrose Terrace, of pre-Bradyan Wisconsinan age, is the most extensive terrace in Fannin County. It is an almost continuous surface in Fannin County, approximately 30 feet above the flood plain along the Red River. The underlying fluvial sediment consists of well sorted basal gravel that grades upward to bedded sand and silt with occasional beds of silty clay. The Ambrose Terrace is a nearly flat plain, except where it is occasionally dissected by streams and where sand dunes and pimple mounds occur.

Soils in the Wilson-Bastrop general soil map unit developed on the Ambrose Terrace from the vicinity of the Grayson-Fannin County line eastward to Caney Creek. Areas of the Karma-Derly general soil map unit are east of Caney Creek to Bois d’ Arc Creek.

The Cooke Terrace in Fannin County is most prominent in areas along the Red River where meanders have deflected the river course northward. The terrace does not occur or is diminished in areas where the course of the river is deflected southward. The terrace is essentially continuous, however, along the southeast or east side of Bois d’Arc Creek from the confluence with the Red River to Ward Creek, northwest of the Allens Chapel community.

The Cooke Terrace is approximately 17 feet above the flood plain along the Red River and about 25 feet above the flood plain along Bois d’Arc Creek. It is a flat to undulating surface underlain by post-Bradyan fluvial sediments. The sediments consist primarily of sand and silt with lesser amounts of clay and are red to tan on the surface. East of Mulberry Bottom, the terrace overlies undifferentiated shale of the Eagle Ford Formation. West of Mulberry Bottom, it overlies members of the Woodbine Formation. Along Bois d’Arc Creek, it overlies members of the Eagle Ford Formation, Bonham Marl, and Blossom Sand.

Karma, Okay, and Muldrow soils are at the higher elevations. Norwood soils are at the lower elevations adjacent to the larger streams that flow into the Red River. Soils of the Severn-Belk-Redlake general soil map unit overlie Holocene alluvium between the Cooke Terrace and the Red River.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvial cone. The material washed down the sides of mountains and hills by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep, conical mass descending equally in all directions from the point of issue.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alpha,alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo. The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Bajada. A broad alluvial slope extending from the base of a mountain range out into a basin and formed by coalescence of separate alluvial fans.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottomland. The normal flood plain of a stream, subject to flooding.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

Cable yarding. A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds directly beneath the solum, or it is exposed at the surface by erosion.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Cement rock. Shaly limestone used in the manufacture of cement.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clastics. Pertaining to rock or sediment composed mainly of fragments derived from preexisting rocks or minerals and moved from their place of origin.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small dune of fine grained soil material stabilized around shrubs or small trees.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cuesta. A hill or ridge that has a gentle slope on one side and a steep slope on the other; specifically, an asymmetric, homoclinal ridge capped by resistant rock layers of slight or moderate dip.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a

body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Desert pavement. On a desert surface, a layer of gravel or larger fragments that was emplaced by upward movement of the underlying sediments or that remains after finer particles have been removed by running water or the wind.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained.* These classes are defined in the “Soil Survey Manual.”

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth’s surface.

Fan terrace. A relict alluvial fan, no longer a site of

active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands,

commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A, O, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Interfluve. A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

Intermittent stream. A stream, or reach of a stream,

that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lamella. A thin, discontinuous or continuous, generally horizontal layer of fine material (especially clay and iron oxides) that has been illuviated within a coarser, eluviated layer.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flat topped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the

greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Native pasture. Areas that were in timber in the past that now, after harvesting, consist of native grasses and other plants. Some timber may still be present.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as “saturated hydraulic conductivity,” which is defined in the “Soil Survey Manual.” In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as “permeability.” Terms describing permeability, measured in inches per hour, are as follows:

Very slow	less than .06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more

than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Playa. The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rectified channel. A stream channel that has been changed or modified from a meandering stream channel to a straight channel. This practice is used to increase floodwater runoff in order to reduce the amount of time that an area is flooded.

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced

matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by induration of a clay, silty clay, or silty clay loam deposit and having the tendency to split into thin layers.the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

Nearly level	0 to 1 percent
Very gently sloping	1 to 3 percent
Gently sloping	3 to 5 percent
Moderately sloping	5 to 8 percent
Strongly sloping	8 to 12 percent
Moderately steep	12 to 20 percent
Steep	20 to 45 percent
Very steep	45 percent and higher

Classes for complex slopes are as follows:

Nearly level	0 to 3 percent
Gently undulating	1 to 5 percent
Undulating	1 to 8 percent
Rolling	5 to 10 percent
Strongly rolling	5 to 16 percent
Hilly	10 to 30 percent
Steep	20 to 45 percent
Very steep	45 percent and higher

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Underlying material. The part of the soil below the solum.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and

away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

Tables

Table 1.--Temperature and Precipitation

(Recorded in the period 1961-90 at Bonham, Texas)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	53.3	30.3	41.8	78	6	44	2.02	0.71	3.10	4	0.8
February----	58.2	34.8	46.5	81	10	75	3.11	1.59	4.63	4	1.1
March-------	67.7	43.2	55.4	87	20	223	3.90	2.09	5.48	5	.3
April-------	76.1	52.0	64.1	90	31	424	3.81	1.45	5.79	5	.0
May---------	82.6	60.0	71.3	94	42	659	6.06	2.89	8.79	6	.0
June--------	89.5	67.4	78.4	99	52	852	4.49	2.25	6.44	5	.0
July--------	94.2	71.1	82.7	104	58	1,006	3.23	1.21	5.11	3	.0
August------	94.8	70.4	82.6	105	57	1,011	2.22	.86	3.36	3	.0
September---	86.7	63.5	75.1	101	42	752	4.86	1.61	7.53	4	.0
October-----	77.1	52.5	64.8	94	32	458	4.10	.90	6.61	4	.0
November----	65.4	42.2	53.8	84	19	183	3.50	1.42	5.25	4	.2
December----	55.8	33.5	44.6	78	9	56	2.70	1.10	4.04	4	.4
Yearly:											
Average---	75.1	51.7	63.4	---	---	---	---	---	---	---	---
Extreme---	---	---	---	106	4	---	---	---	---	---	---
Total-----	---	---	---	---	---	5,744	43.99	34.71	51.47	51	2.8

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

Table 2.--Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Bonham, Texas)

Probability	Temperature		
	24 ^{o}F or lower	28 ^{o}F or lower	32 ^{o}F or lower
Last freezing temperature in spring:			
1 year in 10 later than---	March 10	March 31	April 12
2 years in 10 later than--	March 4	March 24	April 7
5 years in 10 later than--	February 21	March 10	March 28
First freezing temperature in fall:			
1 year in 10 earlier than	November 9	October 29	October 23
2 years in 10 earlier than	November 17	November 4	October 28
5 years in 10 earlier than	December 2	November 15	November 7

Table 3.--Growing Season

(Recorded in the period 1961-90 at Bonham, Texas)

Probability	Daily minimum temperature during growing season		
	Number of days higher than 24 ^{o}F	Number of days higher than 28 ^{o}F	Number of days higher than 32 ^{o}F
9 years in 10------------	247	222	202
8 years in 10------------	255	230	210
5 years in 10------------	269	247	224
2 years in 10------------	284	263	238
1 year in 10-------------	292	272	246

Table 4.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
AbC	Aubrey loam, 2 to 6 percent slopes	965	0.2
AbE	Aubrey fine sandy loam, 8 to 20 percent slopes	420	0.1
AuB	Austin silty clay loam, 1 to 3 percent slopes	6,558	1.1
BaC	Bastrop loam, 2 to 5 percent slopes	1,698	0.3
Be	Belk clay, rarely flooded	3,057	0.5
BkA	Benklin silt loam, 0 to 1 percent slopes	1,928	0.3
BmC	Birome fine sandy loam, 2 to 5 percent slopes	1,328	0.2
BmD	Birome fine sandy loam, 5 to 12 percent slopes	2,108	0.4
BoB	Bonham silt loam, 1 to 3 percent slopes	10,092	1.8
BoC	Bonham silt loam, 3 to 5 percent slopes	765	0.1
BuA	Burleson clay, 0 to 1 percent slopes	4,583	0.8
CrB	Crockett loam, 1 to 3 percent slopes	17,088	3.0
CrC2	Crockett loam, 2 to 5 percent slopes, eroded	6,923	1.2
CtC	Crosstell fine sandy loam, 2 to 5 percent slopes	3,406	0.6
CtD2	Crosstell fine sandy loam, 5 to 12 percent slopes, eroded	2,477	0.4
DaC	Dalco clay, 3 to 5 percent slopes	2,887	0.5
De	Dela loam, occasionally flooded	1,568	0.3
Df	Dela loam, frequently flooded	4,715	0.8
DgA	Derly silt loam, 0 to 1 percent slopes	5,267	0.9
DrA	Derly-Raino complex, 0 to 1 percent slopes	17,702	3.1
Eb	Elbon silty clay loam, frequently flooded	930	0.2
EsD2	Ellis clay, 5 to 12 percent slopes, eroded	6,134	1.1
FaA	Fairlie clay, 0 to 1 percent slopes	12,034	2.1
FdB	Fairlie-Dalco complex, 1 to 3 percent slopes	61,595	10.7
FeD2	Ferris clay, 5 to 12 percent slopes, eroded	25,734	4.5
FhB	Freestone-Hicota complex, 0 to 2 percent slopes	17,148	3.0
Fr	Frioton silty clay loam, occasionally flooded	28,162	4.9
HeB	Heiden clay, 1 to 3 percent slopes	4,735	0.8
HfC2	Heiden-Ferris complex, 2 to 6 percent slopes, eroded	18,706	3.2
Hm	Hopco silt loam, occasionally flooded	1,249	0.2
Hn	Hopco silt loam, frequently flooded	3,676	0.6
HoB	Houston Black clay, 1 to 3 percent slopes	28,112	4.9
HwC	Howe-Whitewright complex, 3 to 5 percent slopes	12,412	2.2
IvA	Ivanhoe silt loam, 0 to 1 percent slopes	30,414	5.3
KaA	Karma loam, 0 to 2 percent slopes	10,914	1.9
KaD2	Karma loam, 5 to 12 percent slopes, eroded	6,628	1.2
KoD	Konawa fine sandy loam, 5 to 8 percent slopes	960	0.2
LaD	Lamar clay loam, 5 to 8 percent slopes	3,416	0.6
LcA	Larton loamy fine sand, 0 to 2 percent slopes	1,418	0.2
LeB	Leson clay, 1 to 3 percent slopes	13,700	2.4
LvB	Lewisville silty clay, 1 to 3 percent slopes	985	0.2
MoD2	Morse clay, 5 to 12 percent slopes, eroded	510	0.1
Mu	Muldrow clay loam, rarely flooded	820	0.1
NoB	Normangee clay loam, 1 to 3 percent slopes	18,661	3.2
NoC2	Normangee clay loam, 2 to 5 percent slopes, eroded	7,183	1.2
Nw	Norwood silt loam, rarely flooded	2,238	0.4
OkA	Okay loam, 0 to 1 percent slopes	3,651	0.6
Om	Oklared-Kiomatia complex, occasionally flooded	3,871	0.7
Or	Orthents, loamy	745	0.1
PoC	Porum loam, 2 to 5 percent slopes	9,645	1.7
PoD	Porum loam, 5 to 12 percent slopes	6,618	1.1
Re	Redlake clay, rarely flooded	3,027	0.5
Se	Severn silt loam, rarely flooded	4,086	0.7
ShB	Stephen silty clay, 1 to 3 percent slopes	3,317	0.6
SrC	Stephen-Rock outcrop complex, 2 to 5 percent slopes	3,097	0.5
SvB	Stephenville fine sandy loam, 1 to 3 percent slopes	1,289	0.2
Tc	Tinn clay, occasionally flooded	12,368	2.1
Tf	Tinn clay, frequently flooded	13,831	2.4
VtC	Vertel clay, 2 to 5 precent slopes	1,593	0.3
VtD	Vertel clay, 5 to 8 percent slopes	1,938	0.3

Table 4.--Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
WaA	Waskom silt loam, 0 to 1 percent slopes	6,353	1.1
WhB	Whakana very fine sandy loam, 1 to 3 percent slopes	7,333	1.3
WhC	Whakana very fine sandy loam, 3 to 5 percent slopes	5,784	1.0
WhD	Whakana very fine sandy loam, 5 to 12 percent slopes	13,989	2.4
Ws	Whitesboro loam, occasionally flooded	505	0.1
Wt	Whitesboro loam, frequently flooded	2,613	0.5
WwD2	Whitewright-Howe complex, 5 to 12 percent slopes, eroded	19,668	3.4
WzA	Wilson silt loam, 0 to 1 percent slopes	33,361	5.8
	Water areas more than 40 acres in size	3,225	0.6
	Total	575,916	100.0

Table 5.--Prime Farmland

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland.)

Map symbol	Soil name
AuB	Austin silty clay loam, 1 to 3 percent slopes
BaC	Bastrop loam, 2 to 5 percent slopes
Be	Belk clay, rarely flooded
BkA	Benklin silt loam, 0 to 1 percent slopes
BoB	Bonham silt loam, 1 to 3 percent slopes
BoC	Bonham silt loam, 3 to 5 percent slopes
BuA	Burleson clay, 0 to 1 percent slopes
DaC	Dalco clay, 3 to 5 percent slopes
De	Dela loam, occasionally flooded
FaA	Fairlie clay, 0 to 1 percent slopes
FdB	Fairlie-Dalco complex, 1 to 3 percent slopes
FhB	Freestone-Hicota complex, 0 to 2 percent slopes
Fr	Frioton silty clay loam, occasionally flooded
HeB	Heiden clay, 1 to 3 percent slopes
Hm	Hopco silt loam, occasionally flooded
HoB	Houston Black clay, 1 to 3 percent slopes
KaA	Karma loam, 0 to 2 percent slopes
LeB	Leson clay, 1 to 3 percent slopes
LvB	Lewisville silty clay, 1 to 3 percent slopes
Nw	Norwood silt loam, rarely flooded
OkA	Okay loam, 0 to 1 percent slopes
Re	Redlake clay, rarely flooded
Se	Severn silt loam, rarely flooded
Tc	Tinn clay, occasionally flooded
WaA	Waskom silt loam, 0 to 1 percent slopes
WhB	Whakana very fine sandy loam, 1 to 3 percent slopes
WhC	Whakana very fine sandy loam, 3 to 5 percent slopes
Ws	Whitesboro loam, occasionally flooded

Table 6.--Land Capability and Yields per Acre of Crops and Pasture

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil.)

Soil name and map symbol	Land capability	Wheat	Grain sorghum	Soybeans	Corn	Peanuts	Improved bermuda-grass	Tall fescue
		Bu	Bu	Bu	Bu	Lbs	AUM*	AUM*
AbC------------- Aubrey	IIIe	---	40	---	---	---	5.0	---
AbE------------- Aubrey	VIe	---	---	---	---	---	2.0	---
AuB------------- Austin	IIIe	35	75	---	80	---	6.5	---
BaC------------- Bastrop	IIIe	---	45	---	60	800	5.5	---
Be-------------- Belk	IIIs	---	80	35	---	---	8.0	8.0
BkA------------- Benklin	IIw	53	90	44	65	---	10.0	8.0
BmC------------- Birome	IIIe	---	---	---	---	---	6.5	---
BmD------------- Birome	VIe	---	---	---	---	---	4.5	---
BoB------------- Bonham	IIe	30	65	30	---	---	7.5	---
BoC------------- Bonham	IIIe	30	60	---	---	---	7.0	---
BuA------------- Burleson	IIw	40	95	---	85	---	6.0	---
CrB------------- Crockett	IIIe	35	55	30	55	---	6.5	---
CrC2------------ Crockett	IVe	20	45	---	---	---	5.0	---
CtC------------- Crosstell	IVe	---	35	---	50	---	4.5	---
CtD2------------ Crosstell	VIe	---	---	---	---	---	4.0	---
DaC------------- Dalco	IIIe	---	70	---	50	---	6.0	---
De-------------- Dela	IIw	35	65	30	---	---	8.0	6.5
Df-------------- Dela	Vw	---	---	---	---	---	8.0	6.5

See footnotes at end of table.

Table 6.--Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Wheat	Grain sorghum	Soybeans	Corn	Peanuts	Improved bermuda-grass	Tall fescue
		Bu	Bu	Bu	Bu	Lbs	AUM*	AUM*
DgA------------- Derly	IVw	---	---	---	---	---	---	2.0
DrA**:								
Derly----------	IVw	---	---	---	---	---	---	2.0
Raino----------	IIIs	---	70	25	95	---	10.0	---
Eb-------------- Elbon	Vw	---	---	---	---	---	8.0	7.5
EsD2------------ Ellis	VIe	---	---	---	---	---	4.0	---
FaA------------- Fairlie	IIs	40	85	---	90	---	6.0	---
FdB**:								
Fairlie--------	IIe	40	80	---	90	---	6.0	---
Dalco----------	IIe	35	75	---	55	---	6.0	---
FeD2------------ Ferris	VIe	---	---	---	---	---	4.0	---
FhB**:								
Freestone------	IIe	---	---	---	80	---	9.0	---
Hicota---------	IIs	45	55	30	70	1,550	8.0	7.5
Fr-------------- Frioton	IIw	40	65	30	90	---	7.5	---
HeB------------- Heiden	IIe	45	90	---	90	---	7.0	---
HfC2**:								
Heiden---------	IIIe	25	45	---	50	---	6.0	---
Ferris---------	IIIe	20	45	---	---	---	5.5	---
Hm-------------- Hopco	IIw	---	90	---	---	---	10.0	---
Hn-------------- Hopco	Vw	---	---	---	---	---	10.0	---
HoB------------- Houston Black	IIe	45	100	---	100	---	7.0	---
HwC**:								
Howe-----------	IIIe	20	40	---	---	---	5.5	---
Whitewright----	IVe	20	30	---	---	---	3.0	---
IvA------------- Ivanhoe	IIIw	35	55	25	---	1,200	6.0	5.0

See footnotes at end of table.

Table 6.--Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Wheat	Grain sorghum	Soybeans	Corn	Peanuts	Improved bermuda-grass	Tall fescue
		Bu	Bu	Bu	Bu	Lbs	AUM*	AUM*
KaA------------- Karma	IIe	35	55	35	---	1,600	7.5	---
KaD2------------ Karma	VIe	---	---	---	---	---	6.0	---
KoD------------- Konawa	IVe	25	40	---	---	1,300	4.0	---
LaD------------- Lamar	IVe	15	35	---	---	---	5.0	---
LcA------------- Larton	IIIe	---	35	25	90	1,400	6.0	---
LeB------------- Leson	IIe	35	80	---	55	---	7.0	---
LvB------------- Lewisville	IIe	40	80	---	70	---	7.5	---
MoD2------------ Morse	VIe	---	---	---	---	---	---	---
Mu-------------- Muldrow	IIw	---	60	35	---	---	10.0	---
NoB------------- Normangee	IIIe	30	50	---	50	---	8.0	---
NoC2------------ Normangee	IVe	26	40	---	---	---	5.0	---
Nw-------------- Norwood	I	---	90	40	110	---	10.0	---
OkA------------- Okay	I	40	60	30	---	1,800	8.0	---
Om**:								
Oklared--------	IIw	30	65	---	---	1,700	8.0	7.0
Kiomatia-------	IIIs	25	35	23	---	---	7.5	---
Or**. Orthents								
PoC------------- Porum	IIIe	20	35	20	---	900	5.5	---
PoD------------- Porum	VIe	---	---	---	---	---	4.5	---
Re-------------- Redlake	IIIw	35	70	40	90	---	7.0	7.0
Se-------------- Severn	I	45	70	40	100	1,700	8.0	---

See footnotes at end of table.

Table 6.--Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Wheat	Grain sorghum	Soybeans	Corn	Peanuts	Improved bermuda-grass	Tall fescue
		Bu	Bu	Bu	Bu	Lbs	AUM*	AUM*
ShB------------- Stephen	IIIe	20	55	---	---	---	4.0	---
SrC**:								
Stephen--------	IVe	15	50	---	---	---	3.5	---
Rock outcrop---	VIII	---	---	---	---	---	---	---
SvB------------- Stephenville	IIe	30	45	20	---	1,500	4.5	---
Tc-------------- Tinn	IIw	35	90	40	90	---	8.0	---
Tf-------------- Tinn	Vw	---	---	---	---	---	8.0	---
VtC------------- Vertel	IVe	15	25	---	---	---	4.0	---
VtD------------- Vertel	VIe	---	---	---	---	---	3.0	---
WaA------------- Waskom	IIw	---	105	50	85	1,500	9.0	---
WhB------------- Whakana	IIe	---	70	40	65	1,200	8.0	---
WhC------------- Whakana	IIIe	---	65	40	60	1,100	7.5	---
WhD------------- Whakana	IVe	---	60	35	50	1,000	6.5	---
Ws-------------- Whitesboro	IIw	35	75	---	---	---	8.0	6.5
Wt-------------- Whitesboro	Vw	---	---	---	---	---	8.0	6.5
WwD2**:								
Whitewright----	VIe	---	---	---	---	---	2.0	---
Howe-----------	VIe	---	---	---	---	---	3.5	---
WzA------------- Wilson	IIIw	30	55	---	60	---	6.0	---

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** See description of the map unit for composition and behavior characteristics of the map unit.

Table 7.--Rangeland Productivity

(Only the soils that support rangeland vegetation suitable for grazing are listed.)

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
AbC, AbE: Aubrey	Tight Sandy Loam	4,500	3,500	2,000
AuB: Austin	Clay Loam	6,500	5,000	3,000
BaC: Bastrop	Sandy Loam	5,500	4,500	3,000
BmC, BmD: Birome	Tight Sandy Loam	6,500	5,000	3,500
BoB, BoC: Bonham	Clay Loam	7,000	5,500	3,500
BuA: Burleson	Blackland	7,000	5,500	4,000
CrB, CrC2: Crockett	Claypan Prairie	6,000	5,000	3,000
CtC, CtD2: Crosstell	Tight Sandy Loam	4,500	3,500	2,000
DaC: Dalco	Blackland	6,000	5,000	3,500
EsD2: Ellis	Eroded Blackland	4,500	3,500	2,000
FaA: Fairlie	Blackland	7,000	6,000	3,500
FdB*:				
Fairlie	Blackland	7,000	6,000	3,500
Dalco	Blackland	6,000	5,000	3,500
FeD2: Ferris	Eroded Blackland	7,000	5,500	4,000
Fr: Frioton	Loamy Bottomland	7,000	4,600	3,000
HeB: Heiden	Blackland	7,000	6,000	3,500
HfC2*:				
Heiden	Blackland	7,000	6,000	3,500
Ferris	Eroded Blackland	7,000	5,500	4,000
HoB: Houston Black	Blackland	7,000	6,000	3,500

See footnote at end of table.

Table 7.--Rangeland Productivity--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
HwC*:				
Howe	Chalky Ridge	6,500	5,000	3,000
Whitewright	Clay Loam	4,500	3,500	2,000
IvA Ivanhoe	Claypan Prairie	5,000	3,500	2,000
KoD Konawa	Sandy Loam	4,500	3,300	2,500
LaD Lamar	Clay Loam	6,000	4,500	3,000
LeB Leson	Blackland	8,500	7,000	5,000
LvB Lewisville	Clay Loam	6,500	5,500	3,000
NoB, NoC2 Normangee	Claypan Prairie	5,500	4,000	3,000
OkA Okay	Sandy Loam	7,000	5,500	4,500
ShB Stephen	Chalky Ridge	4,500	3,500	2,000
SrC*:				
Stephen	Chalky Ridge	4,500	3,500	2,000
Rock outcrop.				
SvB Stephenville	Sandy Loam	4,500	3,300	2,500
VtC, VtD Vertel	Eroded Blackland	5,000	4,000	3,000
Ws, Wt Whitesboro	Loamy Bottomland	9,000	8,000	6,500
WwD2*:				
Whitewright	Chalky Ridge	4,500	3,500	2,000
Howe	Chalky Ridge	6,500	5,000	3,000
WzA Wilson	Claypan Prairie	6,000	4,500	3,000

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 8.--Woodland Management and Productivity

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available.)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
Be-----------------Belk	7C	Slight	Moderate	Moderate	Slight	Moderate	Sweetgum------------	90	210	Eastern cottonwood, sweetgum, green ash, pecan.
							Water oak-----------	90	207	
							Eastern cottonwood--	100	---	
BkA----------------Benklin	5A	Slight	Slight	Slight	Slight	Moderate	Water oak-----------	74	78	Pecan, green ash, water oak.
De, Df-------------Dela	4A	Slight	Slight	Slight	Slight	Severe	Southern red oak----	80	120	Loblolly pine, shortleaf pine, black walnut, southern red oak.
							Sweetgum------------	90	207	
							Eastern cottonwood--	100	---	
							Shortleaf pine------	80	271	
							Green ash-----------	---	---	
							Hickory-------------	---	---	
DgA----------------Derly	4W	Slight	Moderate	Moderate	Slight	Severe	Water oak-----------	70	54	Water oak, willow oak, sweetgum.
							Willow oak----------	72	57	
DrA**:										
Derly-------------	4W	Slight	Moderate	Moderate	Slight	Severe	Water oak-----------	70	54	Water oak, willow oak, sweetgum.
							Willow oak----------	72	57	
Raino-------------	9W	Slight	Moderate	Slight	Slight	Moderate	Loblolly pine-------	88	310	Loblolly pine, shortleaf pine.
							Shortleaf pine------	80	271	
							Water oak-----------	90	175	
Eb-----------------Elbon	3W	---	---	---	---	---	Green ash-----------	80	120	Pecan, green ash.
							Hackberry-----------	---	---	
							Pecan---------------	---	---	
FhB**:										
Freestone---------	8W	Slight	Moderate	Slight	Slight	Moderate	Loblolly pine-------	80	230	Loblolly pine, slash pine, shortleaf pine.
							Shortleaf pine------	70	173	
							Sweetgum------------	80	120	
Hicota------------	6A	Slight	Slight	Slight	Slight	Slight	Shortleaf pine------	59	84	Loblolly pine.

See footnotes at end of table.

Table 8.--Woodland Management and Productivity--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Volume*	Trees to plant
Fr: Frioton	4C	Slight	Moderate	Moderate	Slight	Slight	Southern red oak	76	91	Eastern cottonwood, pecan.
							Hackberry	---	---	
							Pecan	---	---	
							Water hickory	---	---	
Hm, Hn: Hopco	6W	Slight	Moderate	Slight	Slight	Severe	Water oak	90	175	Water oak, green ash, yellow-poplar.
							Willow oak	---	---	
KaA, KaD2: Karma	7A	Slight	Slight	Slight	Slight	Severe	Eastern cottonwood	90	---	Eastern cottonwood, black walnut, Shumard oak, pecan, green ash, American sycamore.
							Pecan	---	---	
							Green ash	---	---	
							Black walnut	---	---	
LcA: Larton	8S	Slight	Moderate	Moderate	Slight	Slight	Shortleaf pine	70	173	Shortleaf pine, loblolly pine, southern red oak.
							Southern red oak	---	---	
							White oak	---	---	
MoD2: Morse	6T	Moderate	Moderate	Severe	Moderate	Moderate	Loblolly pine	65	95	Eastern redcedar, sweetgum.
							Eastern redcedar	60	---	
							Sweetgum	---	---	
Mu: Muldrow	4W	Slight	Moderate	Moderate	Slight	Slight	Green ash	90	207	Green ash, American sycamore, eastern cottonwood, sweetgum.
							Pecan	80	---	
							Willow oak	---	---	
							Water oak	---	---	
							Hackberry	---	---	
Nw: Norwood	9A	Slight	Slight	Slight	Slight	Slight	Eastern cottonwood	100	---	Eastern cottonwood, water oak.
							Water oak	90	175	
Om**:										
Oklared	9A	Slight	Slight	Slight	Slight	Moderate	Eastern cottonwood	100	---	Eastern cottonwood, American sycamore, pecan, black walnut, sweetgum.
							Pecan	75	---	
							Hackberry	75	---	
Kiomatia	9W	Slight	Moderate	Moderate	Slight	Moderate	Eastern cottonwood	100	---	Eastern cottonwood, sweetgum, black walnut, American sycamore.
							Sweetgum	95	256	

See footnotes at end of table.

Table 8.--Woodland Management and Productivity--Continued

		Management concerns					Potential productivity			
Soil name and map symbol	Ordination symbol	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Volume*	Trees to plant
PoC, PoD: Porum	6C	Slight	Moderate	Moderate	Slight	Moderate	Shortleaf pine	60	87	Shortleaf pine, loblolly pine.
							Southern red oak	60	---	
Re: Redlake	7W	Slight	Severe	Moderate	Slight	Moderate	Eastern cottonwood	90	---	Eastern cottonwood, pecan, American sycamore, green ash.
							Pecan	---	---	
							Black walnut	---	---	
							Green ash	---	---	
Se: Severn	9A	Slight	Slight	Slight	Slight	Moderate	Eastern cottonwood	100	---	Eastern cottonwood, American sycamore, pecan, black walnut.
							Pecan	76	---	
							Hackberry	76	---	
Tc, Tf: Tinn	2W	Slight	Moderate	Moderate	Slight	Severe	Black oak	40	---	Pecan.
							Pin oak	40	---	
							Pecan	50	---	
WaA: Waskom	9W	Slight	Moderate	Slight	Slight	Severe	Eastern cottonwood	100	---	Pecan, eastern cottonwood, green ash, American sycamore.
							Water oak	74	---	
							Pecan	---	---	
WhB, WhC, WhD: Whakana	8A	Slight	Slight	Slight	Slight	Moderate	Loblolly pine	80	230	Loblolly pine, slash pine, sweetgum, southern red oak.
							Shortleaf pine	70	173	
							Sweetgum	80	120	
							Southern red oak	70	84	
Ws, Wt: Whitesboro	5W	Slight	Moderate	Slight	Slight	Moderate	Water oak	80	120	Water oak, pecan.

* Volume is the yield in board feet (Doyle Rule) per acre per year calculated over a 50-year period for fully stocked, natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

Table 9.--Woodland Understory Vegetation

(Only the soils suitable for production of commercial trees are listed.)

Soil name and map symbol	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
		Lb/acre		Pct
Be: Belk	Favorable	6,500	Broomsedge bluestem	15
	Normal	5,500	Purpletop	15
	Unfavorable	4,000	Sedge	15
			Little bluestem	10
			Panicum	10
			Beaked panicum	10
			Switchcane	5
BkA: Benklin	Favorable	4,000	Beaked panicum	10
	Normal	3,000	Sedge	10
	Unfavorable	2,000	Longleaf uniola	10
			Common greenbrier	10
			Virginia wildrye	5
			Switchcane	5
De, Df: Dela	Favorable	5,000	Little bluestem	15
	Normal	3,500	Sedge	10
	Unfavorable	2,500	Panicum	10
			Giant cane	10
			Big bluestem	5
			Indiangrass	5
DgA: Derly	Favorable	4,500	Florida paspalum	15
	Normal	3,500	Virginia wildrye	15
	Unfavorable	2,000	Little bluestem	10
			Beaked panicum	10
			Giant cane	10
			Panicum	10
			Redtop panicum	10
			Carolina jointtail	5
DrA*:				
Derly	Favorable	4,500	Florida paspalum	15
	Normal	3,500	Virginia wildrye	15
	Unfavorable	2,000	Little bluestem	10
			Beaked panicum	10
			Giant cane	10
			Panicum	10
			Redtop panicum	10
			Carolina jointtail	5
Raino	Favorable	2,000	Little bluestem	25
	Normal	1,600	Pinehill bluestem	25
	Unfavorable	1,250	Beaked panicum	10
			Longleaf uniola	10
			Spreading panicum	5
			Brownseed paspalum	5
			Cutover muhly	5
FhB*:				
Freestone	Favorable	2,500	Little bluestem	15
	Normal	1,750	Beaked panicum	15
	Unfavorable	1,000	Longleaf uniola	15
			Purpletop	10
			Panicum	10

See footnote at end of table.

Table 9.--Woodland Understory Vegetation--Continued

Soil name and map symbol	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
		Lb/acre		Pct
FhB*:				
Hicota	Favorable	5,000	Broomsedge bluestem	15
	Normal	3,000	Beaked panicum	10
	Unfavorable	1,000	Longleaf uniola	10
			Panicum	10
			Sedge	10
			Paspalum	10
			Purpletop	5
Fr	Favorable	3,000	Sedge	40
Frioton	Normal	2,100	Beaked panicum	10
	Unfavorable	1,600	Panicum	10
			Little bluestem	5
			Florida paspalum	5
Hm, Hn	Favorable	6,000	Longleaf uniola	15
Hopco	Normal	3,500	Virginia wildrye	10
	Unfavorable	2,000	Beaked panicum	10
			Little bluestem	10
			Sedge	10
			Florida paspalum	5
			Indiangrass	5
			Eastern gamagrass	5
			Giant cane	5
KaA, KaD2	Favorable	2,800	Little bluestem	20
Karma	Normal	2,000	Big bluestem	15
	Unfavorable	1,500	Indiangrass	10
			Beaked panicum	10
			Switchgrass	5
LcA	Favorable	2,000	Little bluestem	15
Larton	Normal	1,400	Panicum	10
	Unfavorable	1,000	Big bluestem	5
			Indiangrass	5
			Broadleaf uniola	5
			Sedge	5
Mu	Favorable	2,600	Beaked panicum	15
Muldrow	Normal	2,000	Sedge	15
	Unfavorable	1,600	Switchgrass	10
			Canada wildrye	10
			Eastern gamagrass	5
			Broadleaf uniola	5
			Greenbrier	5
Nw	Favorable	8,000	Virginia wildrye	15
Norwood	Normal	6,500	Beaked panicum	10
	Unfavorable	5,000	Indiangrass	10
			Little bluestem	10
			Switchgrass	10
			Sedge	10
			Big bluestem	5
			Rustyseed paspalum	5

See footnote at end of table.

Table 9.--Woodland Understory Vegetation--Continued

Soil name and map symbol	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
		Lb/acre		Pct
Om*:				
Oklared	Favorable	8,500	Big bluestem	25
	Normal	6,100	Little bluestem	15
	Unfavorable	4,500	Switchgrass	10
			Canada wildrye	5
			Beaked panicum	5
			Sedge	5
Kiomatia	Favorable	5,000	Beaked panicum	20
	Normal	4,000	Giant cane	20
	Unfavorable	2,500	Sedge	10
			Virginia wildrye	10
			Purpletop	10
			Longleaf uniola	5
PoC, PoD: Porum	Favorable	3,500	Big bluestem	15
	Normal	2,500	Little bluestem	15
	Unfavorable	1,800	Indiangrass	5
			Switchgrass	5
			Longspike tridens	5
			Panicum	5
			Tickclover	5
			Sedge	5
Re: Redlake	Favorable	6,000	Giant cane	15
	Normal	4,000	Canada wildrye	10
	Unfavorable	2,000	Sedge	10
			Switchgrass	10
			Indiangrass	10
			Broadleaf uniola	5
			Eastern gamagrass	5
Se: Severn	Favorable	4,500	Little bluestem	15
	Normal	3,000	Big bluestem	10
	Unfavorable	2,000	Canada wildrye	10
			Panicum	10
			Indiangrass	5
			Switchgrass	5
			Sedge	5
			Scribner panicum	5
Tc, Tf: Tinn	Favorable	7,000	Virginia wildrye	15
	Normal	6,000	Sedge	15
	Unfavorable	4,000	Eastern gamagrass	10
			Switchgrass	10
			Indiangrass	10
			Beaked panicum	5
			Panicum	5
WaA: Waskom	Favorable	3,900	Beaked panicum	10
	Normal	1,900	Panicum	10
	Unfavorable	1,000	Paspalum	10
			Sedge	10
			Florida paspalum	5
			Canada wildrye	5

See footnote at end of table.

Table 9.--Woodland Understory Vegetation--Continued

Soil name and map symbol	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
		Lb/acre		Pct
WhB, WhC, WhD------ Whakana	Favorable	4,000	Longleaf uniola	20
	Normal	2,500	Pinehill bluestem	10
	Unfavorable	1,500	Panicum	10
			Beaked panicum	5
			Purpletop	5
			Gayfeather	5
			Sedge	5
Ws, Wt------------- Whitesboro	Favorable	9,000	Virginia wildrye	15
	Normal	8,000	Beaked panicum	15
	Unfavorable	6,500	Switchgrass	5
			Indiangrass	5
			Little bluestem	5
			White tridens	5
			Panicum	5
			Eastern gamagrass	5

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 10.--Recreational Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated.)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
AbC: Aubrey	Slight	Slight	Moderate: slope, depth to rock.	Slight.
AbE: Aubrey	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
AuB: Austin	Slight	Slight	Moderate: slope.	Slight.
BaC: Bastrop	Slight	Slight	Moderate: slope.	Slight.
Be: Belk	Severe: flooding, percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey.
BkA: Benklin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.
BmC: Birome	Slight	Slight	Moderate: slope.	Slight.
BmD: Birome	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
BoB, BoC: Bonham	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
BuA: Burleson	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.
CrB, CrC2: Crockett	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.
CtC: Crosstell	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
CtD2: Crosstell	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
DaC: Dalco	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
De: Dela	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Df: Dela	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.

Table 10.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
DgA: Derly	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
DrA*:				
Derly	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
Raino	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight.
Eb: Elbon	Severe: flooding.	Moderate: flooding, percs slowly.	Severe: flooding.	Moderate: flooding.
EsD2: Ellis	Moderate: slope, percs slowly, too clayey.	Moderate: slope, too clayey, percs slowly.	Severe: slope.	Moderate: too clayey.
FaA: Fairlie	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
FdB*:				
Fairlie	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
Dalco	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
FeD2: Ferris	Moderate: slope, percs slowly.	Moderate: slope, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
FhB*:				
Freestone	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Hicota	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight.
Fr: Frioton	Severe: flooding.	Moderate: percs slowly.	Moderate: small stones, flooding.	Slight.
HeB: Heiden	Moderate: percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
HfC2*:				
Heiden	Moderate: percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.

See footnote at end of table.

Table 10.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
HfC2*:				
Ferris	Moderate: percs slowly.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
Hm Hopco	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, flooding, percs slowly.	Slight.
Hn Hopco	Severe: flooding.	Moderate: flooding, wetness, percs slowly.	Severe: flooding.	Moderate: flooding.
HoB Houston Black	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey.	Moderate: too clayey.
HwC*:				
Howe	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Whitewright	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
IvA Ivanhoe	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.
KaA Karma	Slight	Slight	Slight	Severe: erodes easily.
KaD2 Karma	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
KoD Konawa	Slight	Slight	Severe: slope.	Slight.
LaD Lamar	Slight	Slight	Severe: slope.	Slight.
LcA Larton	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
LeB Leson	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
LvB Lewisville	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
MoD2 Morse	Severe: percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: slope, too clayey, percs slowly.	Severe: too clayey, erodes easily.

See footnote at end of table.

Table 10.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Mu-------------------- Muldrow	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.
NoB, NoC2------------- Normangee	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
Nw-------------------- Norwood	Severe: flooding.	Slight---------------	Slight---------------	Slight.
OkA------------------- Okay	Slight---------------	Slight---------------	Slight---------------	Slight.
Om*:				
Oklared--------------	Severe: flooding.	Slight---------------	Moderate: flooding.	Slight.
Kiomatia-------------	Severe: flooding.	Slight---------------	Moderate: flooding.	Slight.
Or*. Orthents				
PoC------------------- Porum	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight.
PoD------------------- Porum	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Slight.
Re-------------------- Redlake	Severe: flooding, percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey.
Se-------------------- Severn	Severe: flooding.	Slight---------------	Slight---------------	Slight.
ShB------------------- Stephen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.
SrC*:				
Stephen--------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.
Rock outcrop.				
SvB------------------- Stephenville	Slight---------------	Slight---------------	Moderate: slope, small stones, depth to rock.	Slight.
Tc-------------------- Tinn	Severe: flooding, percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey.

See footnote at end of table.

Table 10.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Tf: Tinn	Severe: flooding, percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, flooding, percs slowly.	Severe: too clayey.
VtC: Vertel	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, depth to rock.	Moderate: too clayey.
VtD: Vertel	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: slope.	Moderate: too clayey.
WaA: Waskom	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.
WhB, WhC: Whakana	Slight	Slight	Moderate: slope.	Slight.
WhD: Whakana	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ws: Whitesboro	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Wt: Whitesboro	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
WwD2*:				
Whitewright	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Howe	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
WzA: Wilson	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: small stones, percs slowly.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 11.--Wildlife Habitat

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated.)

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
AbC------ Aubrey	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
AbE------ Aubrey	Poor	Fair	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
AuB------ Austin	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
BaC------ Bastrop	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
Be------ Belk	Fair	Fair	Good	Good	Good	---	Poor	Poor	Fair	Good	Poor	---
BkA------ Benklin	Good	Good	Good	Good	---	---	Poor	Poor	Good	Good	Poor	---
BmC------ Birome	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
BmD------ Birome	Poor	Fair	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
BoB, BoC------ Bonham	Good	Good	Good	Good	---	Good	Poor	Poor	Good	Good	Poor	Good.
BuA------ Burleson	Good	Good	Poor	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
CrB, CrC2------ Crockett	Fair	Good	Good	Good	---	Good	Poor	Poor	Good	---	Poor	Good.
CtC------ Crosstell	Fair	Fair	Good	Good	---	Good	Poor	Very poor.	Fair	---	Very poor.	Fair.
CtD2------ Crosstell	Poor	Fair	Good	Good	---	Good	Poor	Very poor.	Fair	---	Very poor.	Fair.
DaC------ Dalco	Fair	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
De------ Dela	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Df------ Dela	Poor	Fair	Fair	Good	Good	---	Poor	Poor	Fair	Good	Poor	---
DgA------ Derly	Fair	Fair	Good	Fair	Fair	---	Good	Good	Fair	Fair	Good	---
DrA*:												
Derly------	Fair	Fair	Good	Fair	Fair	---	Good	Good	Fair	Fair	Good	---

See footnote at end of table.

Table 11.--Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
DrA*:												
Raino	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Eb Elbon	Poor	Fair	Fair	Good	Good	---	Poor	Poor	Fair	Good	Poor	---
EsD2 Ellis	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
FaA Fairlie	Good	Good	Fair	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
FdB*:												
Fairlie	Good	Good	Fair	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
Dalco	Fair	Fair	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
FeD2 Ferris	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
FhB*:												
Freestone	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
Hicota	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Fr Frioton	Good	Good	Fair	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
HeB Heiden	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
HfC2*:												
Heiden	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Ferris	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Hm Hopco	Fair	Fair	Good	Good	---	---	Fair	Fair	Fair	Good	Fair	---
Hn Hopco	Poor	Fair	Fair	Good	---	---	Fair	Fair	Fair	Good	Fair	---
HoB Houston Black	Good	Good	Poor	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
HwC*:												
Howe	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Whitewright	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
IvA Ivanhoe	Fair	Fair	Good	---	---	Fair	Fair	Fair	Fair	---	Fair	Fair.

See footnote at end of table.

Table 11.--Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
KaA---------------- Karma	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
KaD2--------------- Karma	Fair	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
KoD---------------- Konawa	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
LaD---------------- Lamar	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
LcA---------------- Larton	Fair	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.	---
LeB---------------- Leson	Good	Good	Poor	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
LvB---------------- Lewisville	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
MoD2--------------- Morse	Poor	Fair	Fair	Fair	Poor	Fair	Poor	Very poor.	Fair	Fair	Very poor.	---
Mu----------------- Muldrow	Fair	Good	Fair	Good	Good	---	Fair	Good	Fair	Good	Fair	---
NoB, NoC2---------- Normangee	Fair	Fair	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Nw----------------- Norwood	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
OkA---------------- Okay	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Om*:												
Oklared-----------	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Kiomatia----------	Poor	Fair	Fair	Fair	---	---	Poor	Very poor.	Fair	Fair	Very poor.	---
Or*. Orthents												
PoC---------------- Porum	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
PoD---------------- Porum	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
Re----------------- Redlake	Fair	Fair	Fair	Good	Good	---	Poor	Poor	Fair	Good	Poor	---

See footnote at end of table.

Table 11.--Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Se: Severn	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
ShB: Stephen	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
SrC*:												
Stephen	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Rock outcrop.												
SvB: Stephenville	Fair	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
Tc: Tinn	Fair	Fair	Fair	Good	---	---	Poor	Fair	Fair	Good	Poor	---
Tf: Tinn	Poor	Fair	Fair	Good	---	---	Poor	Fair	Fair	Fair	Poor	---
VtC: Vertel	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
VtD: Vertel	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
WaA: Waskom	Good	Good	Good	Good	---	---	Poor	Poor	Good	Good	Poor	---
WhB, WhC: Whakana	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
WhD: Whakana	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
Ws: Whitesboro	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
Wt: Whitesboro	Very poor.	Poor	Fair	---	---	Fair	Poor	Poor	Poor	---	Poor	Fair.
WwD2*:												
Whitewright	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Howe	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
WzA: Wilson	Fair	Fair	Good	---	---	Fair	Fair	Fair	Fair	---	Fair	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 12.--Building Site Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AbC--------------- Aubrey	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: droughty, depth to rock.
AbE--------------- Aubrey	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength.	Moderate: droughty, slope, depth to rock.
AuB--------------- Austin	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: depth to rock.
BaC--------------- Bastrop	Slight-----------	Slight-----------	Slight-----------	Moderate: low strength.	Slight.
Be---------------- Belk	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
BkA--------------- Benklin	Severe: wetness.	Moderate: wetness, shrink-swell.	Moderate: wetness, shrink-swell.	Severe: low strength.	Moderate: wetness.
BmC--------------- Birome	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: depth to rock.
BmD--------------- Birome	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength.	Moderate: slope, depth to rock.
BoB, BoC---------- Bonham	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
BuA--------------- Burleson	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
CrB, CrC2--------- Crockett	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: droughty.
CtC--------------- Crosstell	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: droughty.
CtD2-------------- Crosstell	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: droughty, slope.
DaC--------------- Dalco	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.

Table 12.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
De: Dela	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Df: Dela	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
DgA: Derly	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
DrA*:					
Derly	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
Raino	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
Eb: Elbon	Moderate: too clayey, wetness, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: flooding.
EsD2: Ellis	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Severe: too clayey.
FaA: Fairlie	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
FdB*:					
Fairlie	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Dalco	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
FeD2: Ferris	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Severe: too clayey.
FhB*:					
Freestone	Severe: wetness.	Moderate: wetness, shrink-swell.	Moderate: wetness, shrink-swell.	Severe: low strength.	Slight.
Hicota	Moderate: too clayey, wetness.	Slight	Slight	Slight	Slight.
Fr: Frioton	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: flooding.

See footnote at end of table.

Table 12.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
HeB: Heiden	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
HfC2*:					
Heiden	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Ferris	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Hm: Hopco	Severe: wetness.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Hn: Hopco	Severe: wetness.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
HoB: Houston Black	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
HwC*:					
Howe	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: depth to rock.
Whitewright	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Severe: depth to rock.
IvA: Ivanhoe	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
KaA: Karma	Slight	Slight	Slight	Moderate: low strength.	Slight.
KaD2: Karma	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope.	Moderate: slope.
KoD: Konawa	Severe: cutbanks cave.	Slight	Moderate: slope.	Slight	Slight.
LaD: Lamar	Slight	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
LcA: Larton	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: droughty.
LeB: Leson	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.

See footnote at end of table.

Table 12.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
LvB: Lewisville	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
MoD2: Morse	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Severe: too clayey.
Mu: Muldrow	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
NoB, NoC2: Normangee	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
Nw: Norwood	Slight	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
OkA: Okay	Slight	Slight	Slight	Moderate: low strength.	Slight.
Om*:					
Oklared	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Kiomatia	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Or*. Orthents					
PoC: Porum	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
PoD: Porum	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
Re: Redlake	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: too clayey.
Se: Severn	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
ShB: Stephen	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Severe: thin layer, too clayey.
SrC*:					
Stephen	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Severe: thin layer, too clayey.

See footnote at end of table.

Table 12.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
SrC*:					
Rock outcrop.					
SvB-------------- Stephenville	Moderate: depth to rock, dense layer.	Slight-----------	Slight-----------	Slight-----------	Moderate: large stones, depth to rock.
Tc---------------- Tinn	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: too clayey.
Tf---------------- Tinn	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: flooding, too clayey.
VtC, VtD---------- Vertel	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
WaA-------------- Waskom	Severe: wetness.	Moderate: wetness, shrink-swell.	Moderate: wetness, shrink-swell.	Severe: low strength.	Moderate: wetness.
WhB-------------- Whakana	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
WhC-------------- Whakana	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
WhD-------------- Whakana	Moderate: slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Ws---------------- Whitesboro	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Wt---------------- Whitesboro	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
WwD2*:					
Whitewright------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: slope.	Severe: low strength.	Severe: depth to rock.
Howe-------------	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength.	Moderate: slope, depth to rock.
WzA-------------- Wilson	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 13.--Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AbC: Aubrey	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
AbE: Aubrey	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
AuB: Austin	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
BaC: Bastrop	Moderate: percs slowly.	Severe: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Be: Belk	Severe: percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
BkA: Benklin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
BmC: Birome	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
BmD: Birome	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
BoB, BoC: Bonham	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
BuA: Burleson	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
CrB, CrC2: Crockett	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
CtC: Crosstell	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
CtD2: Crosstell	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.

Table 13.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
DaC----------------- Dalco	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
De, Df-------------- Dela	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
DgA----------------- Derly	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
DrA*:					
Derly--------------	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Raino--------------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Eb------------------ Elbon	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack.
EsD2---------------- Ellis	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
FaA----------------- Fairlie	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
FdB*:					
Fairlie------------	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
Dalco--------------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
FeD2---------------- Ferris	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
FhB*:					
Freestone----------	Severe: wetness, percs slowly.	Slight-----------	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Hicota-------------	Severe: wetness, percs slowly.	Severe: seepage.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness, thin layer.

See footnote at end of table.

Table 13.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Fr------------------ Frioton	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
HeB----------------- Heiden	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
HfC2*:					
Heiden-------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Ferris-------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Hm, Hn-------------- Hopco	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack.
HoB----------------- Houston Black	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
HwC*:					
Howe---------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Whitewright--------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, hard to pack.
IvA----------------- Ivanhoe	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
KaA----------------- Karma	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey.
KaD2---------------- Karma	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Moderate: slope.	Fair: too clayey, slope.
KoD----------------- Konawa	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
LaD----------------- Lamar	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
LcA----------------- Larton	Moderate: percs slowly.	Severe: seepage.	Slight-----------	Severe: seepage.	Good.

See footnote at end of table.

Table 13.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
LeB: Leson	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
LvB: Lewisville	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
MoD2: Morse	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Mu: Muldrow	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
NoB, NoC2: Normangee	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Nw: Norwood	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
OkA: Okay	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
Om*:					
Oklared	Severe: flooding, wetness.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Good.
Kiomatia	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: too sandy.
Or*. Orthents					
PoC: Porum	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
PoD: Porum	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
Re: Redlake	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Se: Severn	Moderate: flooding.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too clayey.

See footnote at end of table.

Table 13.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
ShB: Stephen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
SrC*:					
Stephen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Rock outcrop.					
SvB: Stephenville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Tc, Tf: Tinn	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
VtC, VtD: Vertel	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
WaA: Waskom	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
WhB, WhC: Whakana	Moderate: percs slowly.	Severe: seepage.	Slight	Severe: seepage.	Good.
WhD: Whakana	Moderate: percs slowly, slope.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: slope.
Ws, Wt: Whitesboro	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
WwD2*:					
Whitewright	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, hard to pack.
Howe	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
WzA: Wilson	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 14.--Construction Materials

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AbC, AbE-------------- Aubrey	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, too acid.
AuB------------------- Austin	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.
BaC------------------- Bastrop	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Be-------------------- Belk	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BkA------------------- Benklin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
BmC, BmD-------------- Birome	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, too acid.
BoB, BoC-------------- Bonham	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BuA------------------- Burleson	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
CrB, CrC2------------- Crockett	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
CtC, CtD2------------- Crosstell	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
DaC------------------- Dalco	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
De, Df---------------- Dela	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
DgA------------------- Derly	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.

Table 14.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
DrA*:				
Derly	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Raino	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Eb Elbon	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
EsD2 Ellis	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
FaA Fairlie	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
FdB*:				
Fairlie	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Dalco	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
FeD2 Ferris	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
FhB*:				
Freestone	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
Hicota	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
Fr Frioton	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
HeB Heiden	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
HfC2*:				
Heiden	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ferris	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

Table 14.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Hm, Hn: Hopco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
HoB: Houston Black	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
HwC*:				
Howe	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess lime.
Whitewright	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
IvA: Ivanhoe	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
KaA: Karma	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
KaD2: Karma	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
KoD: Konawa	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
LaD: Lamar	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
LcA: Larton	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
LeB: Leson	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LvB: Lewisville	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
MoD2: Morse	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mu: Muldrow	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
NoB, NoC2: Normangee	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Nw: Norwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

Table 14.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
OkA: Okay	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Om*:				
Oklared	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Kiomatia	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Or*. Orthents				
PoC, PoD: Porum	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Re: Redlake	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Se: Severn	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, too clayey.
ShB: Stephen	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey, thin layer.
SrC*:				
Stephen	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey, thin layer.
Rock outcrop.				
SvB: Stephenville	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, area reclaim.
Tc, Tf: Tinn	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
VtC, VtD: Vertel	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
WaA: Waskom	Fair: shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
WhB, WhC: Whakana	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
WhD: Whakana	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.

See footnote at end of table.

Table 14.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ws, Wt: Whitesboro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
WwD2*:				
Whitewright	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
Howe	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess lime.
WzA: Wilson	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 15.--Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
AbC-- Aubrey	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, soil blowing.	Droughty, depth to rock.
AbE-- Aubrey	Severe: slope.	Severe: thin layer.	Deep to water	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
AuB-- Austin	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Depth to rock	Depth to rock.
BaC-- Bastrop	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Erodes easily, soil blowing.	Erodes easily.
Be-- Belk	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Percs slowly.
BkA-- Benklin	Slight	Severe: wetness.	Favorable	Erodes easily, wetness.	Erodes easily.
BmC-- Birome	Moderate: seepage, depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, soil blowing.	Depth to rock.
BmD-- Birome	Moderate: seepage, depth to rock.	Severe: thin layer.	Deep to water	Slope, depth to rock, soil blowing.	Slope, depth to rock.
BoB-- Bonham	Slight	Moderate: hard to pack.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
BoC-- Bonham	Moderate: slope.	Moderate: hard to pack.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
BuA-- Burleson	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
CrB-- Crockett	Slight	Severe: hard to pack.	Deep to water	Erodes easily, percs slowly.	Erodes easily, droughty.
CrC2-- Crockett	Moderate: slope.	Severe: hard to pack.	Deep to water	Erodes easily, percs slowly.	Erodes easily, droughty.
CtC-- Crosstell	Slight	Moderate: hard to pack.	Deep to water	Erodes easily, soil blowing.	Erodes easily, droughty.
CtD2-- Crosstell	Slight	Moderate: hard to pack.	Deep to water	Slope, erodes easily, soil blowing.	Slope, erodes easily, droughty.
DaC-- Dalco	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Depth to rock, percs slowly.	Depth to rock, percs slowly.

Table 15.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
De, Df: Dela	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Favorable.
DgA: Derly	Slight	Severe: ponding.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
DrA*:					
Derly	Slight	Severe: ponding.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Raino	Slight	Severe: hard to pack.	Percs slowly	Erodes easily, wetness, soil blowing.	Erodes easily, percs slowly.
Eb: Elbon	Slight	Moderate: hard to pack, wetness.	Flooding	Wetness	Favorable.
EsD2: Ellis	Slight	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Slope, percs slowly.
FaA: Fairlie	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
FdB*:					
Fairlie	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
Dalco	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Depth to rock, percs slowly.	Depth to rock, percs slowly.
FeD2: Ferris	Slight	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Slope, percs slowly.
FhB*:					
Freestone	Slight	Severe: hard to pack.	Percs slowly	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
Hicota	Severe: seepage.	Severe: piping.	Deep to water	Erodes easily, soil blowing.	Erodes easily.
Fr: Frioton	Slight	Moderate: hard to pack.	Deep to water	Favorable	Favorable.
HeB: Heiden	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
HfC2*:					
Heiden	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
Ferris	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
Hm, Hn: Hopco	Slight	Severe: hard to pack.	Flooding	Erodes easily, wetness.	Erodes easily.

See footnote at end of table.

Table 15.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
HoB: Houston Black	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
HwC*:					
Howe	Moderate: seepage, depth to rock.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock.
Whitewright	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock.
IvA: Ivanhoe	Slight	Severe: hard to pack, wetness.	Percs slowly	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
KaA: Karma	Severe: seepage.	Moderate: thin layer, piping.	Deep to water	Erodes easily	Erodes easily.
KaD2: Karma	Severe: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
KoD: Konawa	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Rooting depth.
LaD: Lamar	Moderate: seepage, slope.	Severe: piping.	Deep to water	Favorable	Favorable.
LcA: Larton	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Droughty.
LeB: Leson	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
LvB: Lewisville	Moderate: seepage.	Moderate: piping, hard to pack.	Deep to water	Erodes easily	Erodes easily.
MoD2: Morse	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, droughty.
Mu: Muldrow	Slight	Severe: wetness.	Percs slowly	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
NoB, NoC2: Normangee	Slight	Severe: hard to pack.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Nw: Norwood	Moderate: seepage.	Severe: thin layer.	Deep to water	Erodes easily	Erodes easily.
OkA: Okay	Severe: seepage.	Moderate: thin layer, piping.	Deep to water	Erodes easily	Erodes easily.

See footnote at end of table.

Table 15.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
Om*:					
Oklared	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Droughty.
Kiomatia	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.	Droughty.
Or*. Orthents					
PoC Porum	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Erodes easily, wetness.	Erodes easily, rooting depth.
PoD Porum	Severe: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Slope, erodes easily, wetness.	Slope, erodes easily, rooting depth.
Re Redlake	Slight	Moderate: hard to pack.	Deep to water	Percs slowly	Percs slowly.
Se Severn	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Droughty.
ShB Stephen	Severe: depth to rock, seepage.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock.
SrC*:					
Stephen	Severe: depth to rock, seepage.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock.
Rock outcrop.					
SvB Stephenville	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Depth to rock, soil blowing.	Depth to rock, rooting depth.
Tc, Tf Tinn	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly.
VtC, VtD Vertel	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Depth to rock, erodes easily.	Erodes easily, droughty.
WaA Waskom	Slight	Severe: wetness.	Favorable	Wetness, soil blowing.	Favorable.
WhB, WhC Whakana	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Favorable.
WhD Whakana	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Slope.
Ws, Wt Whitesboro	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable.

See footnote at end of table.

Table 15.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
WwD2*:					
Whitewright	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, depth to rock.	Slope, depth to rock.
Howe	Moderate: seepage, depth to rock.	Severe: thin layer.	Deep to water	Slope, depth to rock.	Slope, depth to rock.
WzA Wilson	Slight	Severe: hard to pack.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 16.--Engineering Index Properties

(The symbol < means less than. Absence of an entry indicates that data were not estimated.)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
AbC-------------- Aubrey	0-6	Loam-------------	ML, SM	A-4, A-2-4	0	95-100	90-100	70-90	20-55	<30	NP-7
	6-37	Clay-------------	CL, CH	A-7-6	0	95-100	95-100	90-100	51-85	41-60	20-38
	37-45	Weathered bedrock	---	---	---	---	---	---	---	---	---
AbE-------------- Aubrey	0-4	Fine sandy loam	ML, SM	A-4, A-2-4	0	95-100	90-100	70-90	20-55	<30	NP-7
	4-32	Clay-------------	CL, CH	A-7-6	0	95-100	95-100	90-100	51-85	41-60	20-38
	32-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
AuB-------------- Austin	0-15	Silty clay loam, silty clay.	CH, CL	A-7-6	0-5	95-100	90-100	80-100	75-96	45-69	25-44
	15-30	Silty clay, clay, silty clay loam.	CH, CL	A-7-6, A-6	0-5	95-100	90-100	80-100	75-96	35-65	16-40
	30-36	Weathered bedrock	---	---	---	---	---	---	---	---	---
BaC-------------- Bastrop	0-11	Loam-------------	ML, SM, CL-ML, SC-SM	A-4	0	96-100	96-100	80-100	40-65	18-25	2-7
	11-80	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	96-100	96-100	75-100	40-70	26-40	11-22
Be--------------- Belk	0-6	Clay-------------	CL, CH	A-7-6	0	100	100	95-100	85-95	44-68	22-39
	6-27	Clay, silty clay	CL, CH	A-7-6	0	100	100	95-100	85-95	44-72	22-42
	27-60	Stratified silt loam to very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	90-100	70-90	16-26	NP-8
BkA-------------- Benklin	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	23-35	6-15
	8-80	Loam, silty clay loam, clay loam.	CL	A-6, A-7-6	0	100	100	85-100	60-95	30-44	11-22
BmC-------------- Birome	0-6	Fine sandy loam--	SM, SC-SM, ML, CL-ML	A-4, A-2-4	0-5	90-100	90-100	70-90	30-70	16-30	NP-7
	6-20	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	51-85	35-55	15-35
	20-30	Sandy clay, clay loam, sandy clay loam.	CL, SC, GC	A-6, A-7	2-30	70-100	60-100	50-70	40-60	30-45	15-25
	30-36	Weathered bedrock	---	---	---	---	---	---	---	---	---
BmD-------------- Birome	0-4	Fine sandy loam--	SM, SC-SM, ML, CL-ML	A-4, A-2-4	0-5	90-100	90-100	70-90	30-70	16-30	NP-7
	4-30	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	51-85	35-55	15-35
	30-36	Sandy clay, clay loam, sandy clay loam.	CL, SC, GC	A-6, A-7	2-30	70-100	60-100	50-70	40-60	30-45	15-25
	36-46	Weathered bedrock and shale.	---	---	---	---	---	---	---	---	---

Table 16.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
BoB-------------- Bonham	0-10	Silt loam--------	CL	A-4, A-6	0	100	98-100	85-100	70-95	25-40	8-22
	10-17	Silty clay loam, silt loam, clay loam.	CL	A-6	0	100	98-100	90-100	75-98	30-40	13-23
	17-56	Silty clay loam, silty clay.	CL, CH	A-7-6	0	100	98-100	90-100	75-98	46-60	28-35
	56-80	Silty clay loam, clay loam, shaly silty clay.	CL, CH	A-7-6	0	100	98-100	90-100	75-98	44-60	25-35
BoC-------------- Bonham	0-9	Silt loam--------	CL	A-4, A-6	0	100	98-100	85-100	70-95	25-40	8-22
	9-15	Silty clay loam, silt loam, clay loam.	CL	A-6	0	100	98-100	90-100	75-98	30-40	13-23
	15-34	Silty clay loam, silty clay.	CL, CH	A-7-6	0	100	98-100	90-100	75-98	46-60	28-35
	34-80	Silty clay loam, clay loam, shaly silty clay.	CL, CH	A-7-6	0	100	98-100	90-100	75-98	44-60	25-35
BuA-------------- Burleson	0-9	Clay-------------	CH	A-7-6	0-2	90-100	90-100	90-99	67-97	56-75	33-49
	9-60	Clay, silty clay	CH	A-7-6	0-1	90-100	90-100	90-99	80-99	51-75	34-54
	60-80	Clay, silty clay, clay loam.	CH	A-7-6	0-2	90-100	80-100	75-99	67-98	51-75	34-54
CrB-------------- Crockett	0-8	Loam-------------	SM, ML, CL, SC	A-4, A-6	0-2	98-100	94-100	89-100	40-96	15-35	3-15
	8-18	Clay, clay loam, sandy clay.	CH, CL	A-7, A-6	0	89-100	75-100	75-100	60-98	35-59	23-42
	18-46	Clay, clay loam, sandy clay.	CH, CL	A-7, A-6	0	89-100	75-100	75-100	65-98	35-59	23-42
	46-59	Clay loam, sandy clay loam, clay.	CL, CH	A-6, A-7	0-5	90-100	85-100	75-100	50-90	30-60	15-40
	59-80	Stratified loam to clay.	CH, CL	A-7	0-5	90-100	90-100	90-100	70-99	45-71	27-52
CrC2------------- Crockett	0-3	Loam-------------	SM, ML, CL, SC	A-4, A-6	0-2	98-100	94-100	89-100	40-96	15-35	3-15
	3-15	Clay, clay loam, sandy clay.	CH, CL	A-7, A-6	0	89-100	75-100	75-100	60-98	35-59	23-42
	15-50	Clay, clay loam, sandy clay.	CH, CL	A-7, A-6	0	89-100	75-100	75-100	65-98	35-59	23-42
	50-60	Clay loam, sandy clay loam, clay.	CL, CH	A-6, A-7	0-5	90-100	85-100	75-100	50-90	30-60	15-40
	60-80	Stratified loam to clay.	CH, CL	A-7	0-5	90-100	90-100	90-100	70-99	45-71	27-52
CtC-------------- Crosstell	0-6	Fine sandy loam--	SM, ML, SC, CL	A-4	0	90-100	90-100	75-95	40-65	15-31	2-10
	6-44	Clay-------------	CH, CL	A-7-6	0	80-100	80-100	75-98	51-85	42-60	25-40
	44-60	Stratified clay to weathered bedrock.	CH, CL, SC	A-7-6, A-6	0	80-100	80-98	70-96	36-88	35-55	15-35
CtD2------------- Crosstell	0-5	Fine sandy loam--	SM, ML, SC, CL	A-4	0	90-100	90-100	75-95	40-65	15-31	2-10
	5-44	Clay-------------	CH, CL	A-7-6	0	80-100	80-100	75-98	51-85	42-60	25-40
	44-60	Stratified clay to weathered bedrock.	CH, CL, SC	A-7-6, A-6	0	80-100	80-98	70-96	36-88	35-55	15-35

Table 16.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
DaC-------------- Dalco	0-12	Clay-------------	CH, CL	A-7	0	95-100	95-100	85-100	85-98	41-70	23-49
	12-26	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	95-100	95-100	85-100	85-98	45-60	30-41
	26-36	Clay, silty clay	CH, CL	A-7	0	95-100	95-100	85-98	80-98	45-60	30-40
	36-46	Weathered bedrock	---	---	---	---	---	---	---	---	---
De--------------- Dela	0-12	Loam-------------	ML, CL-ML	A-4	0	100	100	94-100	65-85	22-29	2-7
	12-30	Fine sandy loam, sandy loam, loam.	ML, CL, SM, SC	A-4	0	100	98-100	94-100	36-70	15-30	NP-10
	30-80	Stratified loam to loamy fine sand.	ML, CL, SM, SC	A-2, A-4	0	100	98-100	90-100	15-60	15-30	NP-10
Df--------------- Dela	0-10	Loam-------------	ML, CL-ML	A-4	0	100	100	94-100	65-85	22-29	2-7
	10-47	Fine sandy loam, sandy loam, loam.	ML, CL, SM, SC	A-4	0	100	98-100	94-100	36-70	15-30	NP-10
	47-70	Stratified loam to loamy fine sand.	ML, CL, SM, SC	A-2, A-4	0	100	98-100	90-100	15-60	15-30	NP-10
DgA-------------- Derly	0-5	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	85-100	55-90	16-30	NP-10
	5-11	Clay loam, silty clay loam, clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-60	20-36
	11-42	Clay loam, silty clay loam, clay.	CH, CL	A-7, A-6	0	100	100	90-100	75-95	39-60	26-36
	42-80	Loam, clay loam, clay.	CH, CL	A-7, A-6	0	100	100	90-100	56-95	34-60	20-36
DrA*:											
Derly-----------	0-6	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	85-100	55-90	16-30	NP-10
	6-14	Clay loam, silty clay loam, clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-60	20-36
	14-56	Clay loam, silty clay loam, clay.	CH, CL	A-7, A-6	0	100	100	90-100	75-95	39-60	26-36
	56-80	Loam, clay loam, clay.	CH, CL	A-7, A-6	0	100	100	90-100	56-95	34-60	20-36
Raino-----------	0-8	Very fine sandy loam.	ML, CL, CL-ML	A-4	0	95-100	95-100	80-100	51-80	<30	NP-10
	8-26	Loam, fine sandy loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	95-100	95-100	80-100	51-80	<30	NP-10
	26-36	Loam, sandy clay loam, clay loam.	CL, SC, SC-SM, CL-ML	A-6, A-4	0	95-100	95-100	80-100	40-72	20-40	5-20
	36-68	Clay, sandy clay, clay loam.	CH, CL	A-7	0	95-100	95-100	80-100	55-90	46-74	24-45
	68-80	Sandy clay loam, clay loam, clay.	CL, CH	A-7	0	95-100	80-100	80-100	55-90	41-60	18-35
Eb--------------- Elbon	0-22	Silty clay loam	CL, CH	A-7, A-6	0	100	100	95-100	85-100	35-55	15-30
	22-80	Stratified silty clay loam to clay.	CL, CH	A-7, A-6	0	100	100	85-98	80-95	35-55	18-35

See footnote at end of table.

Table 16.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
EsD2 Ellis	0-4	Clay	CH	A-7-6	0-5	95-100	95-100	95-100	75-95	51-75	30-50
	4-30	Clay	CH	A-7-6	0-5	95-100	95-100	95-100	75-95	51-75	30-50
	30-66	Clay	CH	A-7-6	0-5	95-100	95-100	90-100	75-95	51-75	30-50
FaA Fairlie	0-7	Clay	CH, CL	A-7	0	95-100	90-100	90-100	85-100	41-70	25-45
	7-30	Silty clay, clay	CH	A-7	0	95-100	95-100	90-100	85-100	51-80	28-53
	30-50	Silty clay, clay	CH	A-7	0	95-100	90-100	90-100	80-98	51-80	28-53
	50-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
FdB*:											
Fairlie	0-8	Clay	CH, CL	A-7	0	95-100	90-100	90-100	85-100	41-70	25-45
	8-42	Silty clay, clay	CH	A-7	0	95-100	95-100	90-100	85-100	51-80	28-53
	42-54	Silty clay, clay	CH	A-7	0	95-100	90-100	90-100	80-98	51-80	28-53
	54-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Dalco	0-10	Clay	CH, CL	A-7	0	95-100	95-100	85-100	85-98	41-70	23-49
	10-28	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	95-100	95-100	85-100	85-98	45-60	30-41
	28-36	Clay, silty clay	CH, CL	A-7	0	95-100	95-100	85-98	80-98	45-60	30-40
	36-46	Weathered bedrock	---	---	---	---	---	---	---	---	---
FeD2 Ferris	0-6	Clay	CH	A-7-6	0	92-100	92-100	75-100	75-100	51-76	35-55
	6-45	Clay, silty clay	CH	A-7-6	0	92-100	92-100	75-100	72-100	51-78	35-56
	45-80	Shale with clay texture.	CH	A-7-6	0	92-100	92-100	85-100	75-100	61-100	42-75
FhB*:											
Freestone	0-10	Loam	ML, CL-ML, CL	A-4, A-6	0	98-100	95-100	90-100	60-80	19-30	3-12
	10-24	Sandy clay loam, loam, clay loam.	CL, CL-ML	A-6, A-7, A-4	0	95-100	95-100	90-100	55-85	24-46	7-23
	24-44	Clay, clay loam	CL, CH	A-7	0	95-100	95-100	90-100	65-95	42-70	21-44
	44-80	Clay, clay loam	CL, CH	A-7, A-6	0	99-100	98-100	95-100	59-99	39-74	24-48
Hicota	0-14	Loam	ML, CL-ML, SC-SM, SM	A-4	0	100	100	70-100	40-75	16-23	NP-6
	14-26	Loam, clay loam, very fine sandy loam.	CL, CL-ML, SC, SC-SM	A-4, A-6, A-7-6	0	100	100	80-100	40-80	23-49	7-31
	26-80	Clay loam, sandy clay loam, clay.	CH, CL, SC	A-7-6	0	100	100	85-100	45-95	41-55	21-30
Fr Frioton	0-24	Silty clay loam	CL	A-6, A-7	0-2	80-100	75-100	70-100	60-96	36-50	15-28
	24-80	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0-2	80-100	75-100	70-100	60-97	36-60	15-37
HeB Heiden	0-10	Clay	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	10-40	Clay, silty clay	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	40-65	Clay, silty clay	CH, CL	A-7-6	0	95-100	90-100	75-100	70-90	49-80	32-55
	65-80	Clay	CH, CL	A-7-6	0	92-100	92-100	85-100	70-90	49-80	32-55
HfC2*:											
Heiden	0-8	Clay	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	8-40	Clay, silty clay	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	40-58	Clay, silty clay	CH, CL	A-7-6	0	95-100	90-100	75-100	70-90	49-80	32-55
	58-80	Clay	CH, CL	A-7-6	0	92-100	92-100	85-100	70-90	49-80	32-55

See footnote at end of table.

Table 16.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
HfC2*:											
Ferris----------	0-5	Clay-------------	CH	A-7-6	0	92-100	92-100	75-100	75-100	51-76	35-55
	5-42	Clay, silty clay	CH	A-7-6	0	92-100	92-100	75-100	72-100	51-78	35-56
	42-80	Shale with clay texture.	CH	A-7-6	0	92-100	92-100	85-100	75-100	61-100	42-75
Hm--------------- Hopco	0-30	Silt loam--------	CL	A-6, A-7-6	0	100	100	95-100	80-99	30-45	11-22
	30-45	Silty clay loam, clay loam, silt loam.	MH, ML, CL, CH	A-7-6, A-6	0	100	100	95-100	80-99	36-53	14-23
	45-80	Clay loam, silty clay loam, loam.	CL, ML, MH, CH	A-6, A-7-6	0	100	100	90-100	75-99	37-55	13-25
Hn--------------- Hopco	0-8	Silt loam--------	CL	A-6, A-7-6	0	100	100	95-100	80-99	30-45	11-22
	8-45	Silty clay loam, clay loam, silt loam.	MH, ML, CL, CH	A-7-6, A-6	0	100	100	95-100	80-99	36-53	14-23
	45-80	Clay loam, silty clay loam, loam, silt loam.	CL, ML, MH, CH	A-6, A-7-6	0	100	100	90-100	75-99	37-55	13-25
HoB-------------- Houston Black	0-8	Clay-------------	CH	A-7-6	0	97-100	96-100	94-100	88-98	58-90	34-60
	8-37	Clay, silty clay	CH	A-7-6	0	98-100	98-100	92-100	88-97	58-98	37-72
	37-80	Clay, silty clay	CH	A-7-6	0	94-100	93-100	87-100	84-99	51-99	32-78
HwC*:											
Howe------------	0-8	Clay loam--------	CL, CH	A-7-6, A-6	0	95-100	95-100	85-100	60-95	35-52	15-30
	8-27	Silty clay loam, clay loam, silty clay.	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	65-95	35-52	15-30
	27-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
Whitewright-----	0-5	Silty clay loam--	CL, CH	A-6, A-7	0-5	95-100	90-100	80-100	60-98	34-52	15-32
	5-15	Silty clay loam, clay loam, gravelly clay loam.	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	60-98	34-52	15-32
	15-25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
IvA-------------- Ivanhoe	0-13	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	98-100	95-100	85-100	70-98	20-32	1-11
	13-17	Silty clay loam, clay loam, loam.	CL	A-6	0	98-100	95-100	85-100	75-98	30-40	13-21
	17-33	Clay, silty clay	CL, CH	A-7-6	0	98-100	95-100	85-100	80-98	40-64	24-45
	33-84	Clay, silty clay	CL, CH	A-7-6	0	98-100	95-100	85-100	75-98	40-65	24-45
KaA-------------- Karma	0-8	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	100	96-100	50-85	22-35	2-13
	8-44	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-20
	44-80	Fine sandy loam, loam, sandy clay loam.	CL-ML, CL, SM, ML	A-4, A-6	0	100	100	90-100	36-85	15-37	NP-16

See footnote at end of table.

Table 16.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
KaD2------------- Karma	0-6	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	100	96-100	50-85	22-35	2-13
	6-36	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-20
	36-73	Fine sandy loam, loam, sandy clay loam.	CL-ML, CL, SM, ML	A-4, A-6	0	100	100	90-100	36-85	15-37	NP-16
KoD-------------- Konawa	0-14	Fine sandy loam--	CL-ML, ML, SM, SC-SM	A-4	0	100	98-100	94-100	36-60	14-26	NP-7
	14-48	Sandy clay loam, fine sandy loam.	SC, CL, SM, ML	A-4, A-6	0	100	98-100	90-100	36-65	14-37	NP-16
	48-80	Fine sandy loam, sandy clay loam, loamy fine sand.	SM, ML, SC-SM, CL-ML	A-4, A-2, A-6	0	100	98-100	90-100	15-65	0-37	NP-16
LaD-------------- Lamar	0-4	Clay loam--------	CL, CL-ML	A-6, A-4, A-7-6	0	95-100	95-100	85-100	70-100	20-49	5-31
	4-37	Clay loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4, A-7-6	0	95-100	95-100	85-100	70-100	20-49	5-31
	37-65	Clay loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4, A-7-6	0	95-100	95-100	85-100	70-100	20-49	5-31
LcA-------------- Larton	0-23	Loamy fine sand	SM	A-2	0	100	100	90-100	15-35	0-14	NP
	23-60	Fine sandy loam, loam, sandy clay loam.	SM, ML, SC, CL-ML	A-4, A-6	0	100	100	90-100	36-90	14-37	NP-16
	60-80	Sandy clay loam, loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-65	25-37	7-16
LeB-------------- Leson	0-14	Clay-------------	CH	A-7-6	0	98-100	98-100	95-100	85-100	60-90	35-60
	14-48	Clay, silty clay	CH	A-7-6	0	98-100	98-100	95-100	90-100	65-96	45-70
	48-70	Clay, silty clay	CH	A-7-6	0	98-100	95-100	90-100	85-100	65-96	45-70
	70-80	Clay-------------	CH	A-7-6	0	98-100	95-100	90-100	80-100	75-96	55-70
LvB-------------- Lewisville	0-14	Silty clay-------	CL, CH	A-7	0	95-100	95-100	82-99	77-95	41-61	20-37
	14-50	Silty clay, clay loam, silty clay loam.	CL, CH	A-7	0	95-100	95-100	73-99	72-95	40-60	24-36
	50-80	Silty clay, clay loam, silty clay loam.	CL, CH	A-6, A-7	0	75-100	72-99	69-98	62-95	30-55	12-34
MoD2------------- Morse	0-4	Clay-------------	CH	A-7-6	0	100	85-100	85-100	80-100	50-75	25-45
	4-80	Clay-------------	CH	A-7-6	0	100	85-100	85-95	80-95	55-75	30-45
Mu--------------- Muldrow	0-16	Clay loam--------	CL	A-6, A-7	0	100	100	96-100	80-98	33-50	12-26
	16-80	Silty clay loam, silty clay, clay, clay loam.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-60	15-34
NoB-------------- Normangee	0-6	Clay loam--------	CL	A-6, A-7	0	98-100	96-100	90-100	65-95	30-48	11-27
	6-55	Clay, clay loam--	CL, CH	A-7	0	98-100	98-100	90-100	65-96	44-80	22-58
	55-80	Stratified shale and clay.	CL, CH	A-7	0	95-100	90-100	90-100	65-90	41-60	20-35

See footnote at end of table.

Table 16.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
NoC2------------	0-3	Clay loam--------	CL	A-6, A-7	0	98-100	96-100	90-100	65-95	30-48	11-27
Normangee	3-55	Clay, clay loam--	CL, CH	A-7	0	98-100	98-100	90-100	65-96	44-80	22-58
	55-80	Stratified shale and clay.	CL, CH	A-7	0	95-100	90-100	90-100	65-90	41-60	20-35
Nw--------------	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	51-90	20-35	4-15
Norwood	9-60	Silt loam, silty clay loam, loam.	CL	A-6, A-7, A-4	0	100	100	90-100	60-98	25-46	7-26
OkA-------------	0-14	Loam-------------	CL	A-4, A-6	0	100	100	94-100	65-85	30-35	9-13
Okay	14-38	Clay loam, loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	38-65	Loam, sandy clay loam, fine sandy loam.	SM, SC, ML, CL	A-4, A-6	0	100	98-100	90-100	36-90	15-34	NP-13
Om*:											
Oklared---------	0-8	Fine sandy loam--	SM, SC-SM, ML, CL-ML	A-4	0	100	100	94-100	36-60	14-26	NP-7
	8-60	Fine sandy loam, very fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-97	14-31	NP-10
Kiomatia--------	0-9	Loamy fine sand--	SM, SC-SM	A-4, A-2-4	0	100	95-100	80-100	30-45	16-26	NP-7
	9-60	Stratified fine sand to loam.	SM, SC-SM	A-2-4	0	100	95-100	80-100	13-30	16-22	NP-5
Or*. Orthents											
PoC-------------	0-5	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	96-100	50-85	24-37	4-14
Porum	5-16	Loam, silt loam, clay loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-97	30-43	8-19
	16-50	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-60	15-34
	50-80	Silty clay loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6, A-7	0	100	100	90-100	36-98	25-50	7-26
PoD-------------	0-6	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	96-100	50-85	24-37	4-14
Porum	6-16	Loam, silt loam, clay loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-97	30-43	8-19
	16-64	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-60	15-34
	64-80	Silty clay loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6, A-7	0	100	100	90-100	36-98	25-50	7-26
Re--------------	0-6	Clay-------------	CL, CH	A-7	0	100	100	98-100	90-100	41-70	18-38
Redlake	6-30	Silty clay, clay	CL, CH	A-7	0	100	100	98-100	90-100	41-70	18-38
	30-80	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-90	37-55	16-30

See footnote at end of table.

Table 16.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Se--------------- Severn	0-7	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	94-100	65-90	14-31	NP-10
	7-60	Stratified silty clay loam to loamy very fine sand.	ML, CL-ML, SM, CL	A-4, A-6, A-7	0	100	100	94-100	36-97	0-42	NP-19
ShB-------------- Stephen	0-14	Silty clay-------	CL, CH	A-7-6	0-5	85-100	75-100	65-100	51-90	45-70	22-42
	14-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
SrC*:											
Stephen---------	0-12	Silty clay-------	CL, CH	A-7-6	0-5	85-100	75-100	65-100	51-90	45-70	22-42
	12-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
SvB-------------- Stephenville	0-7	Fine sandy loam--	SM, SC-SM, ML, CL-ML	A-2, A-4	0-15	83-100	83-100	80-100	11-60	14-26	NP-7
	7-30	Fine sandy loam, sandy clay loam.	SC, CL, SC-SM, CL-ML	A-4, A-6	0	100	98-100	90-100	36-65	20-37	7-16
	30-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
Tc--------------- Tinn	0-8	Clay-------------	CH, CL	A-7	0	95-100	95-100	85-100	80-100	45-75	25-54
	8-80	Clay, silty clay	CH	A-7	0	95-100	90-100	80-100	80-100	55-75	35-54
Tf--------------- Tinn	0-10	Clay-------------	CH, CL	A-7	0	95-100	95-100	85-100	80-100	45-75	25-54
	10-80	Clay, silty clay	CH	A-7	0	95-100	90-100	80-100	80-100	55-75	35-54
VtC-------------- Vertel	0-9	Clay-------------	CH	A-7-6	0	95-100	95-100	90-100	90-100	60-85	40-60
	9-36	Clay-------------	CH	A-7-6	0	95-100	95-100	90-100	85-100	60-85	40-60
	36-55	Weathered bedrock, clay.	CH	A-7-6	0	95-100	95-100	90-100	85-100	60-97	40-71
VtD-------------- Vertel	0-5	Clay-------------	CH	A-7-6	0	95-100	95-100	90-100	90-100	60-85	40-60
	5-38	Clay-------------	CH	A-7-6	0	95-100	95-100	90-100	85-100	60-85	40-60
	38-60	Weathered bedrock, clay.	CH	A-7-6	0	95-100	95-100	90-100	85-100	60-97	40-71
WaA-------------- Waskom	0-16	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0	100	100	80-95	51-80	21-35	2-12
	16-60	Clay loam, sandy clay loam, loam.	CL	A-6, A-7-6	0	100	100	80-95	51-75	30-43	11-23
	60-80	Sandy clay loam, clay loam, loam.	SC, CL	A-6, A-4	0	100	100	75-90	36-75	26-40	8-18
WhB-------------- Whakana	0-14	Very fine sandy loam.	CL-ML, CL, SC, SC-SM	A-4, A-6	0	100	100	75-98	46-75	16-30	2-14
	14-32	Loam, sandy clay loam, clay loam.	CL	A-4, A-6	0	100	95-100	90-100	70-80	25-40	8-20
	32-65	Loam, sandy clay loam.	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	60-75	21-38	7-24
	65-80	Loam, sandy clay loam.	SC-SM, SC, CL, CL-ML	A-4, A-6	0	100	95-100	80-100	36-65	21-38	6-19

See footnote at end of table.

Table 16.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
WhC-------------- Whakana	0-10	Very fine sandy loam.	CL-ML, CL, SC, SC-SM	A-4, A-6	0	100	100	75-98	46-75	16-30	2-14
	10-24	Loam, sandy clay loam, clay loam.	CL	A-4, A-6	0	100	95-100	90-100	70-80	25-40	8-20
	24-40	Loam, sandy clay loam.	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	60-75	21-38	7-24
	40-80	Loam, sandy clay loam.	SC-SM, SC, CL, CL-ML	A-4, A-6	0	100	95-100	80-100	36-65	21-38	6-19
WhD-------------- Whakana	0-10	Very fine sandy loam.	CL-ML, CL, SC, SC-SM	A-4, A-6	0	100	100	75-98	46-75	16-30	2-14
	10-22	Loam, sandy clay loam, clay loam.	CL	A-4, A-6	0	100	95-100	90-100	70-80	25-40	8-20
	22-45	Loam, sandy clay loam.	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	60-75	21-38	7-24
	45-80	Loam, sandy clay loam.	SC-SM, SC, CL, CL-ML	A-4, A-6	0	100	95-100	80-100	36-65	21-38	6-19
Ws--------------- Whitesboro	0-18	Loam-------------	CL, CL-ML	A-4, A-6	0	100	98-100	85-100	60-85	25-36	6-17
	18-36	Loam, clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	85-100	65-91	30-47	11-27
	36-60	Loam, clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	85-100	60-85	30-47	11-27
Wt--------------- Whitesboro	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0	100	98-100	85-100	60-85	25-36	6-17
	8-36	Loam, clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	85-100	65-91	30-47	11-27
	36-60	Loam, clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	85-100	60-85	30-47	11-27
WwD2*:											
Whitewright-----	0-7	Silty clay loam--	CL, CH	A-6, A-7	0-5	95-100	90-100	80-100	60-98	34-52	15-32
	7-17	Silty clay loam, clay loam, gravelly clay loam.	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	60-98	34-52	15-32
	17-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Howe------------	0-7	Silty clay loam--	CL, CH	A-7-6, A-6	0	95-100	95-100	85-100	60-95	35-52	15-30
	7-32	Silty clay loam, clay loam, silty clay.	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	65-95	35-52	15-30
	32-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
WzA-------------- Wilson	0-8	Silt loam--------	CL	A-6	0	95-100	85-100	80-100	60-96	26-38	11-20
	8-24	Silty clay, clay, clay loam.	CL, CH	A-7-6	0	90-100	80-100	80-100	65-96	43-56	26-37
	24-80	Silty clay, clay, silty clay loam.	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	70-96	38-65	24-48

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 17.--Physical and Chemical Properties of the Soils

(The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated.)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
AbC--------------	0-6	5-15	1.25-1.45	2.0-6.0	0.11-0.17	5.6-7.3	Low----------	0.32	3-2	.5-2
Aubrey	6-37	40-60	1.40-1.60	0.06-0.2	0.08-0.14	3.5-6.0	Moderate-----	0.32		
	37-45	---	---	0.01-0.6	---	---	---	---		
AbE--------------	0-4	5-15	1.25-1.45	2.0-6.0	0.11-0.17	5.6-7.3	Low----------	0.32	3-2	.5-2
Aubrey	4-32	40-60	1.40-1.60	0.06-0.2	0.08-0.14	3.5-6.0	Moderate-----	0.32		
	32-40	---	---	0.01-0.6	---	---	---	---		
AuB--------------	0-15	35-50	1.30-1.40	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	3	1-4
Austin	15-30	35-50	1.40-1.50	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32		
	30-36	---	---	0.06-2.0	---	---	---	---		
BaC--------------	0-11	5-20	1.50-1.65	2.0-6.0	0.11-0.17	5.6-7.8	Low----------	0.37	5	<1
Bastrop	11-80	20-35	1.55-1.65	0.6-2.0	0.15-0.19	5.6-8.4	Low----------	0.32		
Be---------------	0-6	40-65	1.30-1.50	<0.06	0.12-0.18	7.9-8.4	High---------	0.32	5	.5-2
Belk	6-27	45-70	1.30-1.50	<0.06	0.12-0.18	7.9-8.4	High---------	0.32		
	27-60	10-25	1.35-1.55	0.6-2.0	0.16-0.24	7.9-8.4	Low----------	0.28		
BkA--------------	0-8	5-20	1.40-1.55	0.6-2.0	0.15-0.24	5.6-7.3	Moderate-----	0.37	5	1-3
Benklin	8-80	18-35	1.40-1.55	0.2-0.6	0.15-0.24	6.1-8.4	Moderate-----	0.32		
BmC--------------	0-6	8-20	1.35-1.55	0.6-2.0	0.11-0.15	5.6-7.3	Low----------	0.32	3	.5-1
Birome	6-20	35-55	1.20-1.40	0.06-0.2	0.15-0.20	5.1-6.0	Moderate-----	0.28		
	20-30	30-50	1.30-1.45	0.6-2.0	0.10-0.18	5.1-6.0	Moderate-----	0.28		
	30-36	---	---	0.2-2.0	---	---	---	---		
BmD--------------	0-4	8-20	1.35-1.55	0.6-2.0	0.11-0.15	5.6-7.3	Low----------	0.32	3	.5-1
Birome	4-30	35-55	1.20-1.40	0.06-0.2	0.15-0.20	5.1-6.0	Moderate-----	0.28		
	30-36	30-50	1.30-1.45	0.6-2.0	0.10-0.18	5.1-6.0	Moderate-----	0.28		
	36-46	---	---	0.2-2.0	---	---	---	---		
BoB--------------	0-10	15-27	1.35-1.50	0.6-2.0	0.14-0.20	5.1-7.3	Moderate-----	0.37	5	1-3
Bonham	10-17	20-35	1.30-1.50	0.2-0.6	0.12-0.18	5.1-6.5	Moderate-----	0.32		
	17-56	30-45	1.40-1.65	0.06-0.2	0.13-0.18	5.1-7.3	High---------	0.32		
	56-80	27-45	1.45-1.65	0.06-0.2	0.13-0.18	6.6-8.4	High---------	0.32		
BoC--------------	0-9	15-27	1.35-1.50	0.6-2.0	0.14-0.20	5.1-7.3	Moderate-----	0.37	5	1-3
Bonham	9-15	20-35	1.30-1.50	0.2-0.6	0.12-0.18	5.1-6.5	Moderate-----	0.32		
	15-34	30-45	1.40-1.65	0.06-0.2	0.13-0.18	5.1-7.3	High---------	0.32		
	34-80	27-45	1.45-1.65	0.06-0.2	0.13-0.18	6.6-8.4	High---------	0.32		
BuA--------------	0-9	40-60	1.35-1.50	0.01-0.06	0.12-0.18	5.6-8.4	Very high----	0.32	5	1-3
Burleson	9-60	40-60	1.40-1.55	0.01-0.06	0.12-0.18	5.6-8.4	Very high----	0.32		
	60-80	35-60	1.40-1.55	0.01-0.06	0.12-0.18	7.4-8.4	Very high----	0.32		
CrB--------------	0-8	5-20	1.50-1.60	0.6-2.0	0.11-0.20	5.6-7.8	Low----------	0.43	5	.5-2
Crockett	8-18	40-55	1.35-1.60	0.01-0.06	0.08-0.14	5.6-7.3	High---------	0.32		
	18-46	35-55	1.40-1.65	0.01-0.06	0.08-0.14	6.1-8.4	High---------	0.32		
	46-59	20-50	1.50-1.70	0.01-0.06	0.11-0.15	6.1-8.4	Moderate-----	0.32		
	59-80	30-60	1.50-1.70	0.01-0.06	0.11-0.15	6.1-8.4	High---------	0.32		
CrC2-------------	0-3	5-20	1.50-1.60	0.6-2.0	0.11-0.20	5.6-7.8	Low----------	0.43	5	.5-2
Crockett	3-15	40-55	1.35-1.60	0.01-0.06	0.08-0.14	5.6-7.3	High---------	0.32		
	15-50	35-55	1.40-1.65	0.01-0.06	0.08-0.14	6.1-8.4	High---------	0.32		
	50-60	20-50	1.50-1.70	0.01-0.06	0.11-0.15	6.1-8.4	Moderate-----	0.32		
	60-80	30-60	1.50-1.70	0.01-0.06	0.11-0.15	6.1-8.4	High---------	0.32		

Table 17.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
CtC-------------- Crosstell	0-6	5-15	1.50-1.60	0.6-2.0	0.10-0.14	5.6-7.8	Low----------	0.43	3	.3-2
	6-44	40-60	1.35-1.55	<0.06	0.07-0.13	4.5-8.4	High---------	0.37		
	44-60	40-60	1.35-1.55	<0.06	0.09-0.14	6.6-8.4	High---------	0.37		
CtD2------------- Crosstell	0-5	5-15	1.50-1.60	0.6-2.0	0.10-0.14	5.6-7.8	Low----------	0.43	3	.3-2
	5-44	40-60	1.35-1.55	<0.06	0.07-0.13	4.5-8.4	High---------	0.37		
	44-60	40-60	1.35-1.55	<0.06	0.09-0.14	6.6-8.4	High---------	0.37		
DaC-------------- Dalco	0-12	35-60	1.40-1.50	<0.06	0.12-0.18	7.4-8.4	High---------	0.32	3	1-4
	12-26	35-60	1.40-1.55	<0.06	0.12-0.18	7.4-8.4	High---------	0.32		
	26-36	35-60	1.40-1.60	<0.06	0.12-0.18	7.4-8.4	High---------	0.32		
	36-46	---	---	0.06-2.0	---	---	---	---		
De--------------- Dela	0-12	10-18	1.30-1.55	2.0-6.0	0.15-0.20	5.1-7.3	Low----------	0.32	5	<1
	12-30	5-18	1.50-1.70	2.0-6.0	0.10-0.20	5.1-7.3	Low----------	0.32		
	30-80	5-18	1.50-1.70	2.0-6.0	0.07-0.15	5.1-7.3	Low----------	0.20		
Df--------------- Dela	0-10	10-18	1.30-1.55	2.0-6.0	0.15-0.20	5.1-7.3	Low----------	0.32	5	<1
	10-47	5-18	1.50-1.70	2.0-6.0	0.10-0.20	5.1-7.3	Low----------	0.32		
	47-70	5-18	1.50-1.70	2.0-6.0	0.07-0.15	5.1-7.3	Low----------	0.20		
DgA-------------- Derly	0-5	8-20	1.40-1.60	0.6-2.0	0.11-0.16	4.5-6.5	Low----------	0.37	5	.5-2
	5-11	27-40	1.35-1.55	0.06-0.2	0.13-0.18	4.5-6.0	Moderate-----	0.37		
	11-42	35-50	1.25-1.50	0.01-0.06	0.10-0.16	4.5-6.0	High---------	0.32		
	42-80	20-45	1.30-1.55	0.01-0.06	0.10-0.16	5.1-7.3	High---------	0.32		
DrA*:										
Derly-----------	0-6	8-20	1.40-1.60	0.6-2.0	0.11-0.16	4.5-6.5	Low----------	0.37	5	.5-2
	6-14	27-40	1.35-1.55	0.06-0.2	0.13-0.18	4.5-6.0	Moderate-----	0.37		
	14-56	35-50	1.25-1.50	0.01-0.06	0.10-0.16	4.5-6.0	High---------	0.32		
	56-80	20-45	1.30-1.55	0.01-0.06	0.10-0.16	5.1-7.3	High---------	0.32		
Raino-----------	0-8	5-18	1.30-1.40	0.6-2.0	0.11-0.20	4.5-6.5	Low----------	0.43	5	<2
	8-26	5-18	1.35-1.55	0.6-2.0	0.11-0.20	4.5-6.5	Low----------	0.43		
	26-36	18-30	1.45-1.65	0.6-2.0	0.15-0.20	4.5-5.5	Moderate-----	0.43		
	36-68	40-60	1.45-1.65	<0.06	0.12-0.18	4.5-6.5	High---------	0.32		
	68-80	25-50	1.50-1.70	0.06-0.2	0.12-0.18	4.5-6.5	High---------	0.32		
Eb--------------- Elbon	0-22	30-40	1.40-1.52	0.2-0.6	0.14-0.20	7.4-8.4	High---------	0.32	5	1-3
	22-80	35-60	1.30-1.52	0.2-0.6	0.12-0.18	7.4-8.4	High---------	0.32		
EsD2------------- Ellis	0-4	40-50	1.35-1.55	<0.06	0.12-0.18	6.1-8.4	High---------	0.32	3	1-3
	4-30	40-60	1.35-1.55	<0.06	0.12-0.18	6.1-8.4	High---------	0.32		
	30-66	40-60	1.40-1.65	<0.06	0.10-0.15	6.6-8.4	High---------	0.32		
FaA-------------- Fairlie	0-7	35-50	1.35-1.50	<0.06	0.14-0.20	7.4-8.4	High---------	0.32	4	1-4
	7-30	40-60	1.40-1.55	<0.06	0.14-0.20	7.4-8.4	High---------	0.32		
	30-50	40-60	1.40-1.60	<0.06	0.14-0.20	7.4-8.4	High---------	0.32		
	50-60	---	---	0.06-2.0	---	---	---	---		
FdB*:										
Fairlie---------	0-8	35-50	1.35-1.50	<0.06	0.14-0.20	7.4-8.4	High---------	0.32	4	1-4
	8-42	40-60	1.40-1.55	<0.06	0.14-0.20	7.4-8.4	High---------	0.32		
	42-54	40-60	1.40-1.60	<0.06	0.14-0.20	7.4-8.4	High---------	0.32		
	54-60	---	---	0.06-2.0	---	---	---	---		

See footnote at end of table.

Table 17.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
FdB*:										
Dalco	0-10	35-60	1.40-1.50	<0.06	0.12-0.18	7.4-8.4	High	0.32	3	1-4
	10-28	35-60	1.40-1.55	<0.06	0.12-0.18	7.4-8.4	High	0.32		
	28-36	35-60	1.40-1.60	<0.06	0.12-0.18	7.4-8.4	High	0.32		
	36-46	---	---	0.06-2.0	---	---	---	---		
FeD2 Ferris	0-6	40-65	1.40-1.50	0.01-0.06	0.15-0.18	7.9-8.4	Very high	0.32	4	.5-2
	6-45	40-65	1.40-1.50	0.01-0.06	0.12-0.18	7.9-8.4	Very high	0.32		
	45-80	40-75	1.45-1.65	0.01-0.06	0.11-0.15	7.9-8.4	High	0.32		
FhB*:										
Freestone	0-10	7-20	1.35-1.55	0.6-2.0	0.14-0.18	5.1-7.3	Low	0.37	5	.5-2
	10-24	20-35	1.35-1.55	0.2-0.6	0.12-0.17	4.5-6.5	Moderate	0.32		
	24-44	30-50	1.29-1.60	0.06-0.2	0.12-0.18	4.5-6.5	High	0.32		
	44-80	30-55	1.30-1.60	0.06-0.2	0.12-0.18	4.5-7.8	High	0.32		
Hicota	0-14	2-15	1.40-1.60	0.2-6.0	0.11-0.20	5.1-6.5	Low	0.37	5	.5-2
	14-26	10-30	1.40-1.60	0.6-2.0	0.12-0.20	4.5-6.0	Moderate	0.32		
	26-80	25-45	1.40-1.60	0.06-0.2	0.12-0.20	4.5-6.0	High	0.32		
Fr Frioton	0-24	35-39	1.30-1.60	0.2-0.6	0.15-0.22	7.4-8.4	High	0.32	5	1-4
	24-80	35-50	1.30-1.65	0.2-0.6	0.12-0.18	7.4-8.4	High	0.32		
HeB Heiden	0-10	40-60	1.30-1.50	<0.06	0.12-0.18	7.9-8.4	Very high	0.32	5	1-4
	10-40	40-60	1.35-1.55	<0.06	0.12-0.18	7.9-8.4	Very high	0.32		
	40-65	40-60	1.40-1.60	<0.06	0.12-0.18	7.9-8.4	Very high	0.32		
	65-80	40-60	1.45-1.65	<0.06	0.11-0.15	7.9-8.4	Very high	0.32		
HfC2*:										
Heiden	0-8	40-60	1.30-1.50	<0.06	0.12-0.18	7.9-8.4	Very high	0.32	5	1-4
	8-40	40-60	1.35-1.55	<0.06	0.12-0.18	7.9-8.4	Very high	0.32		
	40-58	40-60	1.40-1.60	<0.06	0.12-0.18	7.9-8.4	Very high	0.32		
	58-80	40-60	1.45-1.65	<0.06	0.11-0.15	7.9-8.4	Very high	0.32		
Ferris	0-5	40-65	1.40-1.50	0.01-0.06	0.15-0.18	7.9-8.4	Very high	0.32	4	.5-2
	5-42	40-65	1.40-1.50	0.01-0.06	0.12-0.18	7.9-8.4	Very high	0.32		
	42-80	40-75	1.45-1.65	0.01-0.06	0.11-0.15	7.9-8.4	High	0.32		
Hm Hopco	0-30	20-35	1.35-1.50	0.2-0.6	0.16-0.22	6.6-8.4	Moderate	0.37	5	1-4
	30-45	25-35	1.35-1.50	0.2-0.6	0.16-0.22	6.6-8.4	Moderate	0.37		
	45-80	20-35	1.35-1.55	0.2-0.6	0.15-0.20	6.6-8.4	Moderate	0.37		
Hn Hopco	0-8	20-35	1.35-1.50	0.2-0.6	0.16-0.22	6.6-8.4	Moderate	0.37	5	1-4
	8-45	25-35	1.35-1.50	0.2-0.6	0.16-0.22	6.6-8.4	Moderate	0.37		
	45-80	20-35	1.35-1.55	0.2-0.6	0.15-0.20	6.6-8.4	Moderate	0.37		
HoB Houston Black	0-8	50-60	1.20-1.40	<0.06	0.15-0.20	7.4-8.4	Very high	0.32	5	1-5
	8-37	50-60	1.25-1.50	<0.06	0.12-0.18	7.4-8.4	Very high	0.32		
	37-80	45-65	1.30-1.55	<0.06	0.10-0.16	7.4-8.4	Very high	0.32		
HwC*:										
Howe	0-8	30-45	1.40-1.55	0.6-2.0	0.15-0.18	7.9-8.4	Moderate	0.32	3-2	<2
	8-27	30-45	1.40-1.60	0.6-2.0	0.10-0.18	7.9-8.4	Moderate	0.32		
	27-40	---	---	0.06-2.0	---	---	---	---		
Whitewright	0-5	28-45	1.25-1.45	0.6-2.0	0.15-0.20	7.9-8.4	Moderate	0.32	2-1	<1
	5-15	28-45	1.30-1.50	0.6-2.0	0.13-0.20	7.9-8.4	Moderate	0.32		
	15-25	---	---	0.06-2.0	---	---	---	---		

See footnote at end of table.

Table 17.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
IvA--------------	0-13	8-20	1.30-1.50	0.2-0.6	0.15-0.20	5.6-7.3	Low----------	0.43	5	.3-2
Ivanhoe	13-17	18-35	1.40-1.55	0.2-0.6	0.15-0.18	5.6-7.3	Low----------	0.37		
	17-33	40-50	1.50-1.60	0.00-0.06	0.14-0.18	5.6-6.5	High---------	0.32		
	33-84	40-50	1.50-1.60	0.00-0.06	0.14-0.18	7.4-8.4	High---------	0.32		
KaA--------------	0-8	10-20	1.30-1.55	0.6-2.0	0.15-0.20	5.6-7.8	Low----------	0.37	5-4	<1
Karma	8-44	24-35	1.30-1.70	0.6-2.0	0.14-0.20	5.6-7.8	Low----------	0.32		
	44-80	10-24	1.30-1.70	0.6-6.0	0.13-0.20	5.6-7.8	Low----------	0.37		
KaD2-------------	0-6	10-20	1.30-1.55	0.6-2.0	0.15-0.20	5.6-7.8	Low----------	0.37	5-4	<1
Karma	6-36	24-35	1.30-1.70	0.6-2.0	0.14-0.20	5.6-7.8	Low----------	0.32		
	36-73	10-24	1.30-1.70	0.6-6.0	0.13-0.20	5.6-7.8	Low----------	0.37		
KoD--------------	0-14	8-18	1.40-1.65	2.0-6.0	0.13-0.19	5.1-6.5	Low----------	0.24	5-4	<1
Konawa	14-48	18-30	1.45-1.70	0.6-6.0	0.13-0.19	5.1-7.3	Low----------	0.24		
	48-80	7-30	1.40-1.70	2.0-6.0	0.07-0.19	5.1-6.5	Low----------	0.20		
LaD--------------	0-4	20-35	1.25-1.40	0.6-2.0	0.12-0.15	6.6-8.4	Moderate-----	0.32	5	1-3
Lamar	4-37	20-35	1.30-1.50	0.6-2.0	0.12-0.15	7.9-8.4	Moderate-----	0.32		
	37-65	20-35	1.35-1.60	0.6-2.0	0.12-0.15	7.9-8.4	Moderate-----	0.32		
LcA--------------	0-23	5-10	1.45-1.65	2.0-6.0	0.07-0.11	5.1-6.5	Low----------	0.20	5-4	<1
Larton	23-60	15-25	1.40-1.70	0.6-6.0	0.10-0.19	4.5-6.0	Low----------	0.24		
	60-80	15-25	1.45-1.70	0.6-2.0	0.14-0.19	5.1-6.5	Low----------	0.32		
LeB--------------	0-14	40-60	1.30-1.45	<0.06	0.12-0.18	6.1-8.4	High---------	0.32	5	1-4
Leson	14-48	40-60	1.30-1.50	<0.06	0.12-0.18	6.1-8.4	High---------	0.32		
	48-70	40-60	1.35-1.55	<0.06	0.12-0.18	6.6-8.4	High---------	0.32		
	70-80	40-65	1.40-1.65	<0.06	0.12-0.16	7.4-8.4	High---------	0.32		
LvB--------------	0-14	28-45	1.20-1.40	0.6-2.0	0.16-0.20	7.9-8.4	High---------	0.32	5	1-3
Lewisville	14-50	30-45	1.20-1.45	0.6-2.0	0.14-0.18	7.9-8.4	High---------	0.37		
	50-80	30-50	1.30-1.50	0.6-2.0	0.14-0.18	7.9-8.4	High---------	0.37		
MoD2-------------	0-4	40-60	1.25-1.50	<0.06	0.08-0.17	7.4-8.4	Very high----	0.37	5	.5-2
Morse	4-80	45-60	1.25-1.50	<0.06	0.08-0.17	6.6-8.4	Very high----	0.37		
Mu---------------	0-16	30-40	1.30-1.60	0.2-0.6	0.18-0.22	5.1-6.0	Moderate-----	0.43	5	1-3
Muldrow	16-80	35-50	1.35-1.70	0.00-0.06	0.12-0.22	6.1-8.4	High---------	0.43		
NoB--------------	0-6	25-35	1.50-1.60	0.06-0.2	0.15-0.20	5.6-7.3	Moderate-----	0.37	4	.5-2
Normangee	6-55	35-55	1.55-1.65	<0.06	0.12-0.18	5.6-8.4	High---------	0.32		
	55-80	35-55	1.60-1.70	<0.06	0.12-0.18	6.1-8.4	High---------	0.32		
NoC2-------------	0-3	25-35	1.50-1.60	0.06-0.2	0.15-0.20	5.6-7.3	Moderate-----	0.37	4	.5-2
Normangee	3-55	35-55	1.55-1.65	<0.06	0.12-0.18	5.6-8.4	High---------	0.32		
	55-80	35-55	1.60-1.70	<0.06	0.12-0.18	6.1-8.4	High---------	0.32		
Nw---------------	0-9	10-27	1.30-1.50	0.6-2.0	0.17-0.21	7.4-8.4	Low----------	0.43	5	.5-2
Norwood	9-60	18-35	1.40-1.60	0.6-2.0	0.15-0.22	7.9-8.4	Low----------	0.43		
OkA--------------	0-14	18-25	1.30-1.55	2.0-6.0	0.15-0.20	5.6-6.5	Low----------	0.37	5	1-3
Okay	14-38	20-35	1.40-1.65	0.6-2.0	0.12-0.18	5.1-6.5	Low----------	0.37		
	38-65	15-27	1.40-1.65	0.6-6.0	0.11-0.17	5.1-7.3	Low----------	0.37		
Om*:										
Oklared---------	0-8	10-18	1.30-1.65	2.0-6.0	0.13-0.19	7.4-8.4	Low----------	0.20	5	.5-1
	8-60	10-18	1.30-1.70	2.0-6.0	0.07-0.24	7.4-8.4	Low----------	0.32		

See footnote at end of table.

Table 17.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
Om*:										
Kiomatia	0-9	5-15	1.30-1.60	0.6-2.0	0.10-0.15	6.1-8.4	Low	0.17	5	.3-1
	9-60	2-15	1.40-1.65	6.0-20	0.05-0.10	6.1-8.4	Low	0.17		
Or*. Orthents										
PoC Porum	0-5	15-25	1.30-1.55	0.6-2.0	0.15-0.20	4.5-6.0	Low	0.32	5-4	<1
	5-16	25-35	1.30-1.70	0.6-2.0	0.15-0.24	4.5-5.5	Low	0.43		
	16-50	35-45	1.30-1.75	0.06-0.2	0.12-0.22	4.5-6.0	High	0.37		
	50-80	30-45	1.30-1.75	0.2-0.6	0.17-0.22	5.6-7.8	Moderate	0.32		
PoD Porum	0-6	15-25	1.30-1.55	0.6-2.0	0.15-0.20	4.5-6.0	Low	0.32	5-4	<1
	6-16	25-35	1.30-1.70	0.6-2.0	0.15-0.24	4.5-5.5	Low	0.43		
	16-64	35-45	1.30-1.75	0.06-0.2	0.12-0.22	4.5-6.0	High	0.37		
	64-80	30-45	1.30-1.75	0.2-0.6	0.17-0.22	5.6-7.8	Moderate	0.32		
Re Redlake	0-6	40-50	1.25-1.45	0.06-0.2	0.14-0.20	7.4-8.4	High	0.32	5	<1
	6-30	40-60	1.35-1.60	0.00-0.06	0.12-0.18	7.4-8.4	High	0.32		
	30-80	30-45	1.35-1.65	0.06-0.2	0.15-0.20	7.4-8.4	Moderate	0.43		
Se Severn	0-7	8-17	1.25-1.55	2.0-6.0	0.13-0.24	7.4-8.4	Low	0.32	5	<1
	7-60	8-35	1.35-1.70	2.0-6.0	0.07-0.24	7.9-8.4	Low	0.32		
ShB Stephen	0-14	40-55	1.35-1.55	0.2-0.6	0.10-0.15	7.9-8.4	Moderate	0.32	2	1-4
	14-20	---	---	0.06-2.0	---	---	---	---		
SrC*:										
Stephen	0-12	40-55	1.35-1.55	0.2-0.6	0.10-0.15	7.9-8.4	Moderate	0.32	2	1-4
	12-20	---	---	0.06-2.0	---	---	---	---		
Rock outcrop.										
SvB Stephenville	0-7	10-20	1.40-1.65	2.0-6.0	0.13-0.19	5.1-6.5	Low	0.24	3-2	<1
	7-30	18-35	1.35-1.75	0.6-2.0	0.13-0.19	4.5-6.0	Low	0.32		
	30-40	---	1.85-2.00	0.2-0.6	---	---	---	---		
Tc Tinn	0-8	40-60	1.40-1.50	0.06-0.2	0.15-0.20	7.4-8.4	Very high	0.32	5	1-4
	8-80	40-60	1.40-1.50	0.01-0.06	0.13-0.18	7.4-8.4	Very high	0.32		
Tf Tinn	0-10	40-60	1.40-1.50	0.06-0.2	0.15-0.20	7.4-8.4	Very high	0.32	5	1-4
	10-80	40-60	1.40-1.50	0.01-0.06	0.13-0.18	7.4-8.4	Very high	0.32		
VtC Vertel	0-9	60-80	1.35-1.55	<0.06	0.07-0.14	6.6-7.8	Very high	0.32	3-2	<1
	9-36	60-80	1.35-1.55	<0.06	0.07-0.14	6.6-8.4	Very high	0.37		
	36-55	60-80	1.70-1.95	<0.06	0.0-0.01	6.1-8.4	High	0.37		
VtD Vertel	0-5	60-80	1.35-1.55	<0.06	0.07-0.14	6.6-7.8	Very high	0.32	3-2	<1
	5-38	60-80	1.35-1.55	<0.06	0.07-0.14	6.6-8.4	Very high	0.37		
	38-60	60-80	1.70-1.95	<0.06	0.0-0.01	6.1-8.4	High	0.37		
WaA Waskom	0-16	12-24	1.20-1.50	0.6-2.0	0.13-0.20	5.6-7.3	Low	0.28	5	1-3
	16-60	20-35	1.25-1.55	0.2-0.6	0.15-0.20	6.1-7.8	Moderate	0.32		
	60-80	20-35	1.25-1.55	0.2-0.6	0.12-0.18	6.1-8.4	Moderate	0.32		

See footnote at end of table.

Table 17.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
WhB--------------	0-14	10-25	1.40-1.60	2.0-6.0	0.11-0.18	5.1-7.3	Low----------	0.32	5	0-2
Whakana	14-32	18-35	1.40-1.55	0.6-2.0	0.10-0.15	4.5-6.5	Moderate-----	0.32		
	32-65	18-30	1.40-1.60	2.0-6.0	0.10-0.15	4.5-6.0	Low----------	0.32		
	65-80	18-30	1.45-1.65	0.6-2.0	0.10-0.15	4.5-6.0	Low----------	0.32		
WhC--------------	0-10	10-25	1.40-1.60	2.0-6.0	0.11-0.18	5.1-7.3	Low----------	0.32	5	0-2
Whakana	10-24	18-35	1.40-1.55	0.6-2.0	0.10-0.15	4.5-6.5	Moderate-----	0.32		
	24-40	18-30	1.40-1.60	2.0-6.0	0.10-0.15	4.5-6.0	Low----------	0.32		
	40-80	18-30	1.45-1.65	0.6-2.0	0.10-0.15	4.5-6.0	Low----------	0.32		
WhD--------------	0-10	10-25	1.40-1.60	2.0-6.0	0.11-0.18	5.1-7.3	Low----------	0.32	5	0-2
Whakana	10-22	18-35	1.40-1.55	0.6-2.0	0.10-0.15	4.5-6.5	Moderate-----	0.32		
	22-45	18-30	1.40-1.60	2.0-6.0	0.10-0.15	4.5-6.0	Low----------	0.32		
	45-80	18-30	1.45-1.65	0.6-2.0	0.10-0.15	4.5-6.0	Low----------	0.32		
Ws---------------	0-18	12-20	1.25-1.40	0.6-2.0	0.12-0.18	6.1-7.8	Low----------	0.28	5	1-3
Whitesboro	18-36	22-35	1.30-1.45	0.6-2.0	0.13-0.18	5.6-8.4	Moderate-----	0.28		
	36-60	22-35	1.30-1.55	0.6-2.0	0.13-0.18	6.1-8.4	Moderate-----	0.28		
Wt---------------	0-8	12-20	1.25-1.40	0.6-2.0	0.12-0.18	6.1-7.8	Low----------	0.28	5	1-3
Whitesboro	8-36	22-35	1.30-1.45	0.6-2.0	0.13-0.18	5.6-8.4	Moderate-----	0.28		
	36-60	22-35	1.30-1.55	0.6-2.0	0.13-0.18	6.1-8.4	Moderate-----	0.28		
WwD2*:										
Whitewright-----	0-7	28-45	1.25-1.45	0.6-2.0	0.15-0.20	7.9-8.4	Moderate-----	0.32	2-1	<1
	7-17	28-45	1.30-1.50	0.6-2.0	0.13-0.20	7.9-8.4	Moderate-----	0.32		
	17-30	---	---	0.06-2.0	---	---	---	---		
Howe------------	0-7	30-45	1.40-1.55	0.6-2.0	0.15-0.18	7.9-8.4	Moderate-----	0.32	3-2	<2
	7-32	30-45	1.40-1.60	0.6-2.0	0.10-0.18	7.9-8.4	Moderate-----	0.32		
	32-40	---	---	0.06-2.0	---	---	---	---		
WzA--------------	0-8	18-27	1.35-1.45	0.2-0.6	0.10-0.17	5.6-7.3	Low----------	0.43	5	.5-2
Wilson	8-24	35-50	1.50-1.60	0.01-0.06	0.10-0.16	5.6-7.8	High---------	0.37		
	24-80	35-60	1.50-1.60	0.01-0.06	0.10-0.16	6.6-8.4	High---------	0.37		

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 18.--Soil and Water Features

("Flooding," "water table," and such terms as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated.)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
AbC, AbE-- Aubrey	C	None	---	---	>6.0	---	---	20-40	Soft	High	High.
AuB-- Austin	C	None	---	---	>6.0	---	---	20-40	Soft	High	Low.
BaC-- Bastrop	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low.
Be-- Belk	D	Rare	---	---	>6.0	---	---	>60	---	High	Low.
BkA-- Benklin	C	None	---	---	2.5-3.5	Apparent	Nov-May	>60	---	Moderate	Low.
BmC, BmD-- Birome	C	None	---	---	>6.0	---	---	20-40	Soft	High	Moderate.
BoB, BoC-- Bonham	D	None	---	---	2.5-3.5	Apparent	Oct-May	>60	---	High	Moderate.
BuA-- Burleson	D	None	---	---	>6.0	---	---	>60	---	High	Moderate.
CrB, CrC2-- Crockett	D	None	---	---	>6.0	---	---	>60	---	High	Low.
CtC, CtD2-- Crosstell	D	None	---	---	>6.0	---	---	>60	---	High	Moderate.
DaC-- Dalco	D	None	---	---	>6.0	---	---	24-40	Soft	High	Low.
De-- Dela	B	Occasional	Very brief	Nov-Jul	3.0-5.0	Apparent	Nov-May	>80	---	Moderate	Moderate.
Df-- Dela	B	Frequent	Very brief	Nov-Jul	3.0-5.0	Apparent	Nov-May	>80	---	Moderate	Moderate.
DgA-- Derly	D	None	---	---	0-1.0	Perched	Nov-May	>60	---	High	High.
DrA*:											
Derly	D	None	---	---	0-1.0	Perched	Nov-May	>60	---	High	High.
Raino	D	None	---	---	2.0-3.5	Perched	Dec-May	>60	---	High	Moderate.
Eb-- Elbon	B	Frequent	Brief	Nov-May	2.5-3.5	Apparent	Dec-Apr	>60	---	High	Low.
EsD2-- Ellis	D	None	---	---	>6.0	---	---	>60	---	High	Low.

See footnote at end of table.

Table 18.--Soil and Water Features--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
FaA--------------- Fairlie	D	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	Low.
FdB*:											
Fairlie----------	D	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	Low.
Dalco------------	D	None--------	---	---	>6.0	---	---	24-40	Soft	High-----	Low.
FeD2-------------- Ferris	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
FhB*:											
Freestone--------	C	None--------	---	---	2.0-3.5	Perched	Dec-May	>60	---	High-----	Moderate.
Hicota-----------	B	None--------	---	---	3.0-5.0	Apparent	Nov-May	>60	---	High-----	High.
Fr---------------- Frioton	C	Occasional	Very brief	Feb-Jul	>6.0	---	---	>80	---	High-----	Low.
HeB--------------- Heiden	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
HfC2*:											
Heiden-----------	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Ferris-----------	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Hm---------------- Hopco	C	Occasional	Brief-----	Dec-May	2.0-4.0	Apparent	Dec-May	>60	---	High-----	Low.
Hn---------------- Hopco	C	Frequent----	Brief-----	Dec-May	2.0-4.0	Apparent	Dec-May	>60	---	High-----	Low.
HoB--------------- Houston Black	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
HwC*:											
Howe-------------	C	None--------	---	---	>6.0	---	---	20-40	Soft	High-----	Low.
Whitewright------	C	None--------	---	---	>6.0	---	---	10-20	Soft	High-----	Low.
IvA--------------- Ivanhoe	D	None--------	---	---	0.5-1.5	Perched	Nov-Apr	>60	---	High-----	High.
KaA, KaD2--------- Karma	B	None--------	---	---	>6.0	---	---	>80	---	Low------	Moderate.
KoD--------------- Konawa	B	None--------	---	---	>6.0	---	---	>80	---	Moderate	Moderate.
LaD--------------- Lamar	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
LcA--------------- Larton	A	None--------	---	---	>6.0	---	---	>80	---	Low------	Moderate.
LeB--------------- Leson	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.

See footnote at end of table.

Table 18.--Soil and Water Features--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
LvB--------------- Lewisville	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
MoD2-------------- Morse	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Mu---------------- Muldrow	D	Rare--------	---	---	0-2.0	Apparent	Sep-Mar	>80	---	High-----	Moderate.
NoB, NoC2--------- Normangee	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Nw---------------- Norwood	B	Rare--------	---	---	>6.0	---	---	>60	---	High-----	Low.
OkA--------------- Okay	B	None--------	---	---	>6.0	---	---	>80	---	Moderate	Moderate.
Om*:											
Oklared----------	B	Occasional	Brief-----	Jan-Jul	3.5-5.0	Apparent	Jan-Jul	>80	---	Moderate	Low.
Kiomatia---------	A	Occasional	Brief-----	Jan-Jun	3.5-5.0	Apparent	Jan-Jul	>60	---	Low------	Low.
Or*. Orthents											
PoC, PoD---------- Porum	D	None--------	---	---	2.0-3.0	Perched	Dec-Apr	>80	---	High-----	High.
Re---------------- Redlake	D	Rare--------	---	---	>6.0	---	---	>80	---	High-----	Low.
Se---------------- Severn	B	Rare--------	---	---	>6.0	---	---	>80	---	Low------	Low.
ShB--------------- Stephen	C	None--------	---	---	>6.0	---	---	7-20	Soft	High-----	Low.
SrC*:											
Stephen----------	C	None--------	---	---	>6.0	---	---	7-20	Soft	High-----	Low.
Rock outcrop.											
SvB--------------- Stephenville	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
Tc---------------- Tinn	D	Occasional	Brief-----	Feb-May	>6.0	---	---	>60	---	High-----	Low.
Tf---------------- Tinn	D	Frequent----	Brief-----	Feb-May	>6.0	---	---	>60	---	High-----	Low.
VtC, VtD---------- Vertel	D	None--------	---	---	>6.0	---	---	24-40	Soft	High-----	Low.
WaA--------------- Waskom	C	None--------	---	---	1.5-2.5	Apparent	Dec-May	>60	---	High-----	Low.

See footnote at end of table.

Table 18.--Soil and Water Features--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
WhB, WhC, WhD: Whakana	B	None	---	---	>6.0	---	---	>60	---	Moderate	High.
Ws: Whitesboro	C	Occasional	Brief	Sep-May	>6.0	---	---	>60	---	High	Low.
Wt: Whitesboro	C	Frequent	Brief	Sep-May	>6.0	---	---	>60	---	High	Low.
WwD2*:											
Whitewright	C	None	---	---	>6.0	---	---	10-20	Soft	High	Low.
Howe	C	None	---	---	>6.0	---	---	20-40	Soft	High	Low.
WzA: Wilson	D	None	---	---	>6.0	---	---	>60	---	High	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 19.--Engineering Index Test Data

Soil name, report number, horizon, and depth in inches	Classification: AASHTO	Classification: Unified	Grain-size distribution: Percentage passing sieve--: 5/8 inch	3/8 inch	No. 4	No. 10	No. 40	Percentage smaller than--: No. 200	.05 mm	.005 mm	.002 mm	Liquid limit	Plasticity index	Specific gravity	Shrinkage: Limit	Shrinkage: Linear	Shrinkage: Ratio
												Pct			Pct	Pct	
Bonham silt loam:[1] (S84TX-147-4)																	
A 0-10	A-6(15)	CL	100	100	100	100	100	95	80	24	18	38	14	2.58	24.0	6.6	1.60
Bt1 10-17	A-6(18)	CH	100	100	100	100	100	96	82	34	29	36	19	2.62	18.0	9.0	1.79
Bt2 17-30	A-7-6(38)	CH	100	100	100	100	100	97	93	49	42	52	37	2.63	14.0	17.2	1.96
Bt4 42-56	A-7-6(31)	CL	100	100	100	100	99	96	87	40	35	46	31	2.69	14.0	15.0	1.95
Dalco clay:[1] (S84TX-147-2)																	
A1 0-10	A-7-6(50)	CH	100	100	100	100	99	95	83	50	42	61	49	2.60	11.0	20.9	2.01
A2 10-28	A-7-6(39)	CH	100	100	98	96	93	89	87	55	48	60	41	2.69	10.0	20.9	2.06
Bss 28-36	A-7-6(37)	CH	100	100	97	95	92	89	86	56	49	59	38	2.64	10.0	20.5	2.04
Derly silt loam:[1] (S84TX-147-6)																	
Ap 0-6	A-4(3)	CL	100	100	100	100	99	67	55	25	22	25	9	2.60	16.0	5.0	1.79
Btg/E 6-14	A-6(18)	CL	100	100	100	100	99	78	73	44	39	38	25	2.61	10.0	13.8	2.02
Btg2 30-44	A-6(17)	CL	100	100	100	100	98	73	66	39	35	39	26	2.62	11.0	13.6	2.02
Btg4 76-80	A-6(8)	CL	100	100	100	100	99	56	52	32	29	34	22	2.60	14.0	10.2	1.89
Fairlie clay:[1] (S84TX-147-1)																	
Ap 0-8	A-7-6(35)	CH	100	99	99	98	97	94	90	51	45	55	34	2.68	10.0	19.7	2.05
Bss2 20-42	A-7-6(53)	CH	100	100	99	99	97	94	90	61	54	72	50	2.66	10.0	24.2	2.11
Bkss 42-54	A-7-6(50)	CH	100	99	96	94	91	89	86	60	52	72	51	2.67	10.0	24.8	2.11
Freestone loam:[1] (S85TX-147-7)																	
A 0-5	A-6(4)	CL	100	100	100	100	99	66	49	5	2	19	12	2.63	20.0	0.0	1.63
Bt1 10-18	A-6(6)	CL	100	100	100	100	100	73	61	28	24	26	11	2.65	17.0	5.0	1.82
Btg/E2 30-44	A-7-6(30)	CH	100	100	100	100	100	80	71	44	44	54	37	2.63	15.0	16.9	1.89
Bt'2 72-80	A-6(11)	CL	100	100	100	100	100	59	50	32	30	39	24	2.64	18.0	10.2	1.79
Frioton silty clay loam:[1, 2] (S84TX-147-3)																	
A1 8-24	A-7-6(29)	CL	100	100	100	100	100	96	92	56	46	47	28	2.67	14.0	15.3	1.98
A2 24-60	A-7-6(40)	CH	100	100	100	100	99	97	88	63	48	58	37	2.67	12.0	19.5	1.99
C1 60-70	A-7-6(33)	CL	100	100	100	100	99	97	93	68	52	49	32	2.69	12.0	17.2	2.05

See footnotes at end of table.

Table 19.--Engineering Index Test Data--Continued

Soil name, report number, horizon, and depth in inches	Classification: AASHTO	Classification: Unified	Percentage passing sieve--: 5/8 inch	3/8 inch	No. 4	No. 10	No. 40	Percentage smaller than--: No. 200	.05 mm	.005 mm	.002 mm	Liquid limit	Plasticity index	Specific gravity	Shrinkage: Limit	Shrinkage: Linear	Shrinkage: Ratio
												Pct			Pct	Pct	
Hicota loam: (S84TX-147-8)																	
A 0-4	A-4(0)	CL	100	100	100	100	99	60	48	10	8	18	1	2.62	17.0	0.0	1.71
E/Bt 14-26	A-4(0)	CL	100	100	100	100	99	61	50	14	12	17	2	2.63	18.0	0.0	1.78
Bt1 32-44	A-6(13)	CL	100	100	100	100	100	73	62	36	35	35	21	2.69	15.0	10.2	1.87
Bt2 44-54	A-7-6(23)	CL	100	100	100	100	100	78	68	44	41	47	31	2.64	13.0	15.2	1.91
Hopco silt loam: (S85TX-147-2)																	
A1 0-8	A-6(10)	CL	100	100	100	100	99	96	82	24	19	31	11	2.64	22.0	4.6	1.68
A2 8-30	A-6(18)	CL	100	100	100	100	100	97	83	24	24	36	18	2.63	19.0	8.3	1.74
A3 30-45	A-6(18)	CL	100	100	100	100	100	97	77	26	25	38	18	2.63	19.0	9.1	1.75
Bw 45-65	A-6(22)	CL	100	100	100	100	100	97	88	30	26	39	22	2.66	18.0	10.1	1.79
Howe clay loam:[3] (S85TX-147-5)																	
A 0-8	A-7-6(25)	CL	100	100	100	100	99	93	75	51	38	48	24	2.59	17.0	13.9	1.82
Bk1 8-16	A-7-6(24)	CL	100	100	100	100	98	92	78	67	50	48	23	2.69	22.0	11.0	1.66
Bk2 16-27	A-7-6(16)	CH	100	95	87	76	62	60	56	46	30	55	30	2.69	25.0	12.0	1.60
Ivanhoe silt loam:[1] (S85TX-147-8)																	
A 5-13	A-4(0)	CL	100	100	100	100	99	86	64	16	11	21	1	2.64	18.0	1.5	1.70
Bt2 17-33	A-7-6(47)	CH	100	100	100	100	100	95	90	59	54	64	45	2.65	10.0	21.9	2.05
Btg1 33-51	A-7-6(32)	CH	100	100	100	100	99	92	82	41	36	49	34	2.72	13.0	16.1	1.95
BCg 68-84	A-7-6(38)	CH	100	100	100	100	100	93	89	46	42	53	39	2.54	12.0	17.8	1.98
Kiomatia loamy fine sand:[1] (S84TX-147-10)																	
A 0-9	A-4(0)	SP	100	100	100	100	100	45	28	6	4	18	1	2.64	20.0	0.0	1.65
C 9-50	A-2-4(0)	SP	100	100	100	100	100	16	10	6	5	19	0	2.60	19.0	0.0	1.61
Lamar clay loam:[1] (S84TX-147-5)																	
Bk1 4-26	A-7-6(28)	CL	100	100	100	100	100	99	97	75	53	45	26	2.71	17.0	13.3	1.84
Bk2 26-37	A-7-6(33)	CL	100	100	100	100	99	98	92	68	56	49	31	2.71	14.0	15.7	1.94
Ck 37-65	A-7-6(24)	CL	100	100	100	100	100	99	98	77	57	43	22	2.67	19.0	11.3	1.79

See footnotes at end of table.

Table 19.--Engineering Index Test Data--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit	Plasticity index	Specific gravity	Shrinkage		
			Percentage passing sieve--					Percentage smaller than--									
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct			Pct	Pct	
Leson clay:[1] (S85TX-147-1)																	
A1 0-14	A-7-6(65)	CH	100	100	100	100	100	99	97	70	60	78	58	2.68	9.0	25.7	2.06
Bss1 14-36	A-7-6(71)	CH	100	100	100	100	100	99	91	70	60	82	63	2.67	11.0	25.7	2.02
Bkss 48-70	A-7-6(52)	CH	100	100	99	97	95	93	89	62	52	69	51	2.69	11.0	22.9	2.05
Ck 70-80	A-7-6(75)	CH	100	100	100	100	100	99	98	80	66	86	67	2.69	11.0	26.3	2.00
Normangee clay loam:[1] (S84TX-147-11)																	
Ap 0-6	A-6(24)	CL	100	100	100	100	99	93	84	32	28	38	27	2.63	17.0	10.2	1.81
Bt1 6-21	A-7-6(35)	CL	100	100	100	100	99	95	87	40	35	49	35	2.69	10.0	18.0	1.99
Bt3 39-55	A-7-6(37)	CH	100	100	98	98	98	93	86	43	38	52	38	2.66	13.0	12.4	1.99
Raino very fine sandy loam:[1, 4] (S84TX-147-7)																	
Ap 0-8	A-4(0)	CL	100	99	99	98	97	54	41	14	12	18	2	2.62	18.0	0.0	1.82
BE 8-26	A-4(1)	CL	100	100	100	100	99	62	46	20	18	19	6	2.63	15.0	2.7	1.87
Bt/E2 36-43	A-7-6(16)	CL	100	100	100	100	99	65	58	34	30	42	29	2.62	15.0	12.7	1.87
Btg2 68-80	A-6(8)	CL	100	100	100	100	99	57	47	26	21	31	20	2.63	16.0	7.8	1.79
Vertel clay:[1] (S84TX-147-9)																	
Bss1 9-20	A-7-6(41)	CH	100	100	100	99	98	88	82	63	60	62	43	2.69	8.0	22.4	2.10
Bss2 20-36	A-7-6(62)	CH	100	100	100	99	99	95	93	75	70	80	58	2.69	12.0	25.1	2.00
Cr 36-55	A-7-6(81)	CH	100	100	100	100	100	98	92	83	72	97	71	2.71	11.0	28.6	2.04
Whitesboro loam: (S85TX-147-4)																	
A1 0-18	A-6 (9)	CL	100	100	100	100	100	87	72	29	23	30	11	2.56	20.0	5.4	1.72
B21 18-36	A-7-6(25)	CL	100	100	100	100	100	91	84	38	33	42	27	2.66	14.0	13.3	1.91
B22 36-63	A-7-6(22)	CL	100	100	100	100	100	84	70	36	31	42	27	2.67	14.0	13.4	1.94
C 63-80	A-7-6(20)	CL	100	100	100	100	100	81	55	22	15	40	26	2.72	14.0	12.5	1.92

See footnotes at end of table.

Table 19.--Engineering Index Test Data--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit	Plasti-city index	Specific gravity	Shrinkage		
			Percentage passing sieve--					Percentage smaller than--									
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct			Pct	Pct	
Whitewright clay loam:[1] (S85TX-147-6)																	
A 0-7	A-7-6(22)	CL	100	100	100	100	98	88	70	53	40	47	23	2.63	16.0	13.6	1.80
Bk 7-17	A-7-6(19)	CL	100	98	96	95	93	83	73	62	52	47	21	2.60	20.0	17.5	1.71

[1] This is the series type location pedon.

[2] The Frioton soils in Fannin County are taxadjuncts to the series. The mineralogy is smectitic rather than mixed.

[3] This pedon is a taxadjunct to the series. The amount of chalk fragments retained on the number 10 sieve is greater than is allowed for the series. These fragments typically disperse upon soaking in calgon or if rubbed when moist.

[4] The Raino soils in Fannin County are taxadjuncts to the series. They do not have a dual textural family.

Table 20.--Classification of the Soils

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.)

Soil name	Family or higher taxonomic class
*Aubrey	Clayey, mixed, thermic Typic Haplustults
Austin	Fine-silty, carbonatic, thermic Udorthentic Haplustolls
Bastrop	Fine-loamy, mixed, thermic Udic Paleustalfs
Belk	Clayey over loamy, mixed, thermic Entic Hapluderts
Benklin	Fine-silty, mixed, thermic Aquic Argiudolls
Birome	Fine, mixed, thermic Ultic Paleustalfs
Bonham	Fine, smectitic, thermic Aquic Argiudolls
Burleson	Fine, smectitic, thermic Udic Haplusterts
Crockett	Fine, smectitic, thermic Udertic Paleustalfs
Crosstell	Fine, smectitic, thermic Udertic Paleustalfs
Dalco	Fine, smectitic, thermic Leptic Udic Haplusterts
Dela	Coarse-loamy, siliceous, nonacid, thermic Typic Udifluvents
Derly	Fine, smectitic, thermic Typic Glossaqualfs
Elbon	Fine, smectitic, thermic Fluventic Hapludolls
Ellis	Fine, smectitic, thermic Udertic Ustochrepts
Fairlie	Fine, smectitic, thermic Udic Haplusterts
Ferris	Fine, smectitic, thermic Chromic Udic Haplusterts
Freestone	Fine-loamy, siliceous, thermic Glossaquic Paleudalfs
*Frioton	Fine, mixed, thermic Cumulic Hapludolls
Heiden	Fine, smectitic, thermic Udic Haplusterts
Hicota	Coarse-loamy, siliceous, thermic Typic Glossudalfs
Hopco	Fine-silty, mixed, thermic Cumulic Haplaquolls
Houston Black	Fine, smectitic, thermic Udic Haplusterts
Howe	Fine-silty, carbonatic, thermic Udic Ustochrepts
Ivanhoe	Fine, smectitic, thermic Aeric Ochraqualfs
Karma	Fine-loamy, mixed, thermic Typic Hapludalfs
Kiomatia	Sandy, mixed, thermic Typic Udifluvents
Konawa	Fine-loamy, mixed, thermic Ultic Haplustalfs
Lamar	Fine-silty, mixed, thermic Udic Ustochrepts
Larton	Loamy, siliceous, thermic Arenic Paleudalfs
Leson	Fine, smectitic, thermic Udic Haplusterts
Lewisville	Fine-silty, mixed, thermic Udic Calciustolls
Morse	Fine, mixed, thermic Chromic Hapluderts
Muldrow	Fine, mixed, thermic Typic Argiaquolls
Normangee	Fine, smectitic, thermic Udertic Haplustalfs
Norwood	Fine-silty, mixed (calcareous), thermic Typic Udifluvents
Okay	Fine-loamy, mixed, thermic Typic Argiudolls
Oklared	Coarse-loamy, mixed (calcareous), thermic Typic Udifluvents
Porum	Fine, mixed, thermic Glossaquic Paleudalfs
*Raino	Fine-loamy over clayey, siliceous, thermic Aquic Glossudalfs
Redlake	Fine, mixed, thermic Vertic Eutrochrepts
Severn	Coarse-silty, mixed (calcareous), thermic Typic Udifluvents
Stephen	Clayey, mixed, thermic, shallow Udorthentic Haplustolls
Stephenville	Fine-loamy, siliceous, thermic Ultic Haplustalfs
Tinn	Fine, smectitic, thermic Typic Hapluderts
Vertel	Very-fine, smectitic, thermic Leptic Udic Haplusterts
Waskom	Fine-loamy, mixed, thermic Aquic Argiudolls
Whakana	Fine-loamy, mixed, thermic Glossic Paleudalfs
Whitesboro	Fine-loamy, mixed, thermic Cumulic Haplustolls
Whitewright	Loamy, carbonatic, thermic, shallow Typic Ustochrepts
Wilson	Fine, smectitic, thermic Oxyaquic Vertic Haplustalfs

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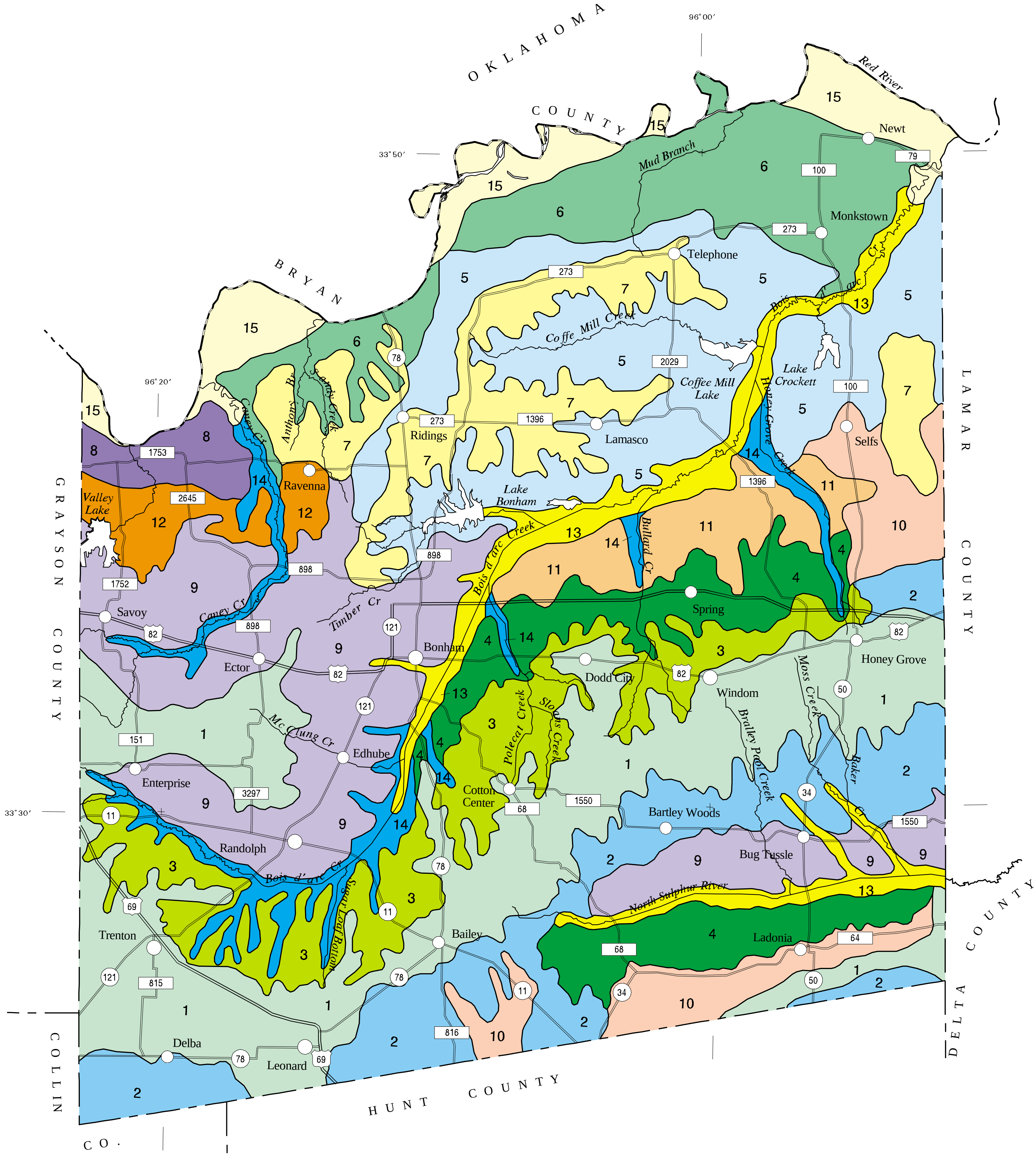


SOIL LEGEND*

CLAYEY AND LOAMY, SLIGHTLY ACID TO MODERATELY ALKALINE SOILS ON UPLANDS

1 Fairlie-Dalco

2 Houston Black-Leson

3 Whitewright-Howe

4 Ferris

LOAMY, VERY STRONGLY ACID TO NEUTRAL SOILS ON TERRACES

5 Whakana-Porum-Freestone

6 Karma-Derly

7 Ivanhoe

8 Wilson-Bastrop

LOAMY AND CLAYEY, MODERATELY ACID TO NEUTRAL SOILS ON UPLANDS

9 Normangee-Wilson-Bonham

10 Crockett

11 Ellis-Crockett

12 Crosstell-Birome

CLAYEY AND LOAMY, MODERATELY ALKALINE SOILS ON FLOOD PLAINS

13 Tinn

14 Frioton

15 Seven-Belk-Redlake

*The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 1988

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION
TEXAS STATE SOIL AND WATER CONSERVATION BOARD
UNITED STATES FOREST SERVICE

GENERAL SOIL MAP

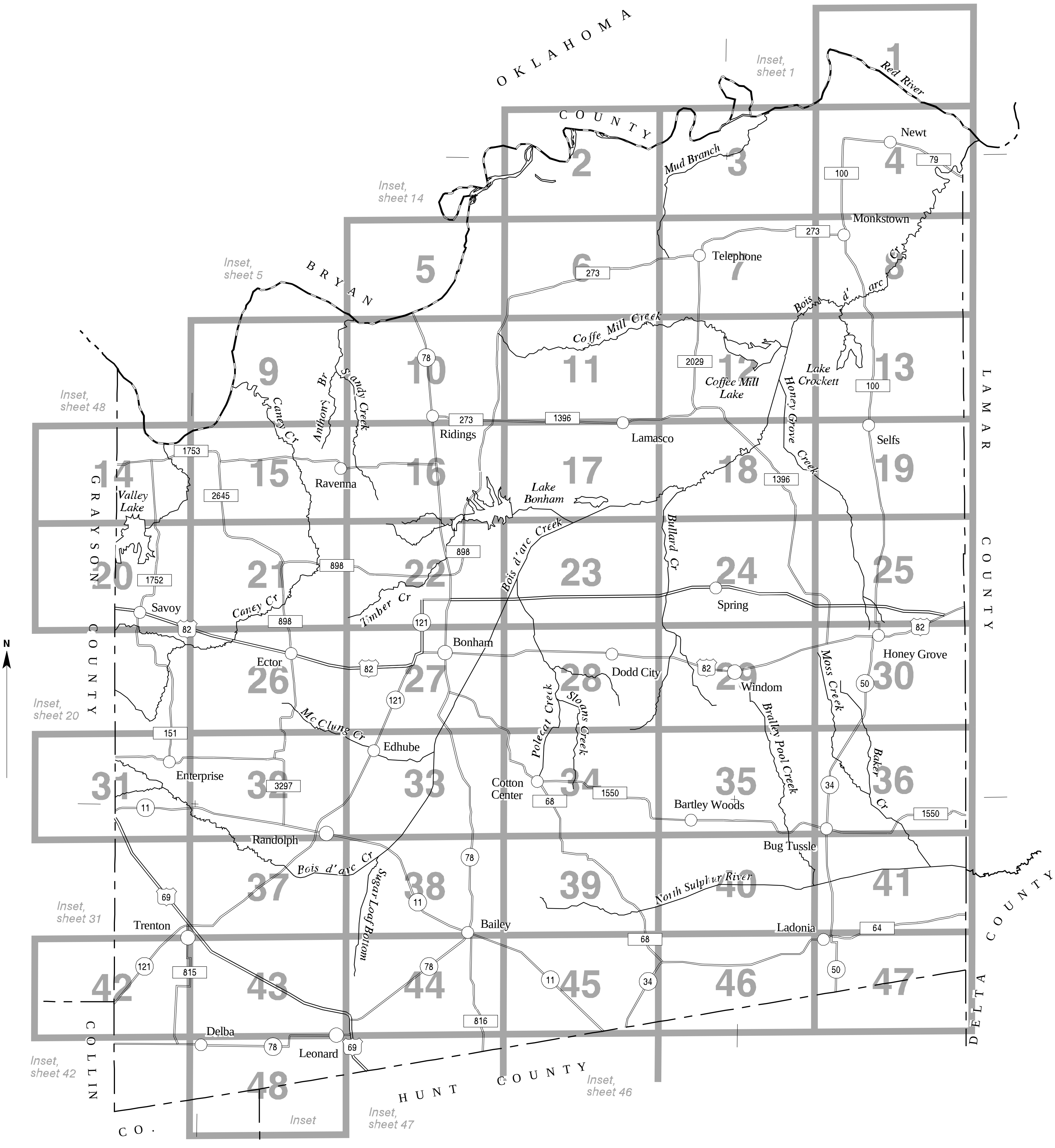
FANNIN COUNTY, TEXAS

Scale 1:253440

1 0 1 2 3
MILES

1 0 1 2 3 4 5 6
KILOMETERS

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

FANNIN COUNTY, TEXAS

Scale 1:253440

MILES

KILOMETERS

SOIL LEGEND

Map symbols consist of a combination of letters and numbers. The first letter is always a capital and is the first letter of the soil name. The second letter is lower case. The third letter is a capital letter used to show slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is eroded.

SYMBOL	NAME
AbC	Aubrey loam, 2 to 6 percent slopes
AbE	Aubrey fine sandy loam, 8 to 20 percent slopes
AuB	Austin silty clay loam, 1 to 3 percent slopes
BaC	Bastrop loam, 2 to 5 percent slopes
Be	Belk clay, rarely flooded
BkA	Benklin silt loam, 0 to 1 percent slopes
BmC	Birome fine sandy loam, 2 to 5 percent slopes
BmD	Birome fine sandy loam, 5 to 12 percent slopes
BoB	Bonham silt loam, 1 to 3 percent slopes
BoC	Bonham silt loam, 3 to 5 percent slopes
BuA	Burleson clay, 0 to 1 percent slopes
CrB	Crockett loam, 1 to 3 percent slopes
CrC2	Crockett loam, 2 to 5 percent slopes, eroded
CtC	Crosstell fine sandy loam, 2 to 5 percent slopes
CtD2	Crosstell fine sandy loam, 5 to 12 percent slopes, eroded
DaC	Dalco clay, 3 to 5 percent slopes
De	Dela loam, occasionally flooded
Df	Dela loam, frequently flooded
DgA	Derly silt loam, 0 to 1 percent slopes
DrA	Derly-Raino complex, 0 to 1 percent slopes
Eb	Elbon silty clay loam, frequently flooded
EsD2	Ellis clay, 5 to 12 percent slopes, eroded
FaA	Fairlie clay, 0 to 1 percent slopes
FdB	Fairlie-Dalco complex, 1 to 3 percent slopes
FeD2	Ferris clay, 5 to 12 percent slopes, eroded
FhB	Freestone-Hicota complex, 0 to 2 percent slopes
Fr	Frioton silty clay loam, occasionally flooded
HeB	Heiden clay, 1 to 3 percent slopes
HfC2	Heiden-Ferris complex, 2 to 6 percent slopes, eroded
Hm	Hopco silt loam, occasionally flooded
Hn	Hopco silt loam, frequently flooded
HoB	Houston Black clay, 1 to 3 percent slopes
HwC	Howe-Whitewright complex, 3 to 5 percent slopes
IvA	Ivanhoe silt loam, 0 to 1 percent slopes
KaA	Karma loam, 0 to 2 percent slopes
KaD2	Karma loam, 5 to 12 percent slopes, eroded
KoD	Konawa fine sandy loam, 5 to 8 percent slopes
LaD	Lamar clay loam, 5 to 8 percent slopes
LcA	Larton loamy fine sand, 0 to 2 percent slopes
LeB	Leson clay, 1 to 3 percent slopes
LvB	Lewisville silty clay, 1 to 3 percent slopes
MoD2	Morse clay, 5 to 12 percent slopes, eroded
Mu	Muldrow clay loam, rarely flooded
NoB	Normangee clay loam, 1 to 3 percent slopes
NoC2	Normangee clay loam, 2 to 5 percent slopes, eroded
Nw	Norwood silt loam, rarely flooded
OkA	Okay loam, 0 to 1 percent slopes
Om	Oklared-Kiomatia complex, occasionally flooded
Or	Orthents, loamy
PoC	Porum loam, 2 to 5 percent slopes
PoD	Porum loam, 5 to 12 percent slopes
Re	Redlake clay, rarely flooded
Se	Severn silt loam, rarely flooded
ShB	Stephen silty clay, 1 to 3 percent slopes
SrC	Stephen-Rock outcrop complex, 2 to 5 percent slopes
SvB	Stephenville fine sandy loam, 1 to 3 percent slopes
Tc	Tinn clay, occasionally flooded
Tf	Tinn clay, frequently flooded
VtC	Vertel clay, 2 to 5 percent slopes
VtD	Vertel clay, 5 to 8 percent slopes
WaA	Waskom silt loam, 0 to 1 percent slopes
WhB	Whakana very fine sandy loam, 1 to 3 percent slopes
WhC	Whakana very fine sandy loam, 3 to 5 percent slopes
WhD	Whakana very fine sandy loam, 5 to 12 percent slopes
Ws	Whitesboro loam, occasionally flooded
Wt	Whitesboro loam, frequently flooded
WwD2	Whitewright-Howe complex, 5 to 12 percent slopes, eroded
WzA	Wilson silt loam, 0 to 1 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state, or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK
1 890 000 FEET

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 173
- Federal — 287
- State — 52
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small (Named where applicable)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban area) (occupied)
- Church
- School
- Indian mound (label)
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — Nw Se

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

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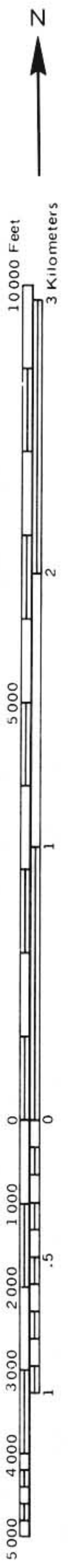
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

FANNIN COUNTY, TEXAS — SHEET NUMBER 2



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FANNIN COUNTY, TEXAS — SHEET NUMBER 3

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FANNIN COUNTY, TEXAS — SHEET NUMBER 6

N

10 000 Feet
3 Kilometers
5 000
0
1000
2000
3000
4000
5 000
Scale - 1:24 000

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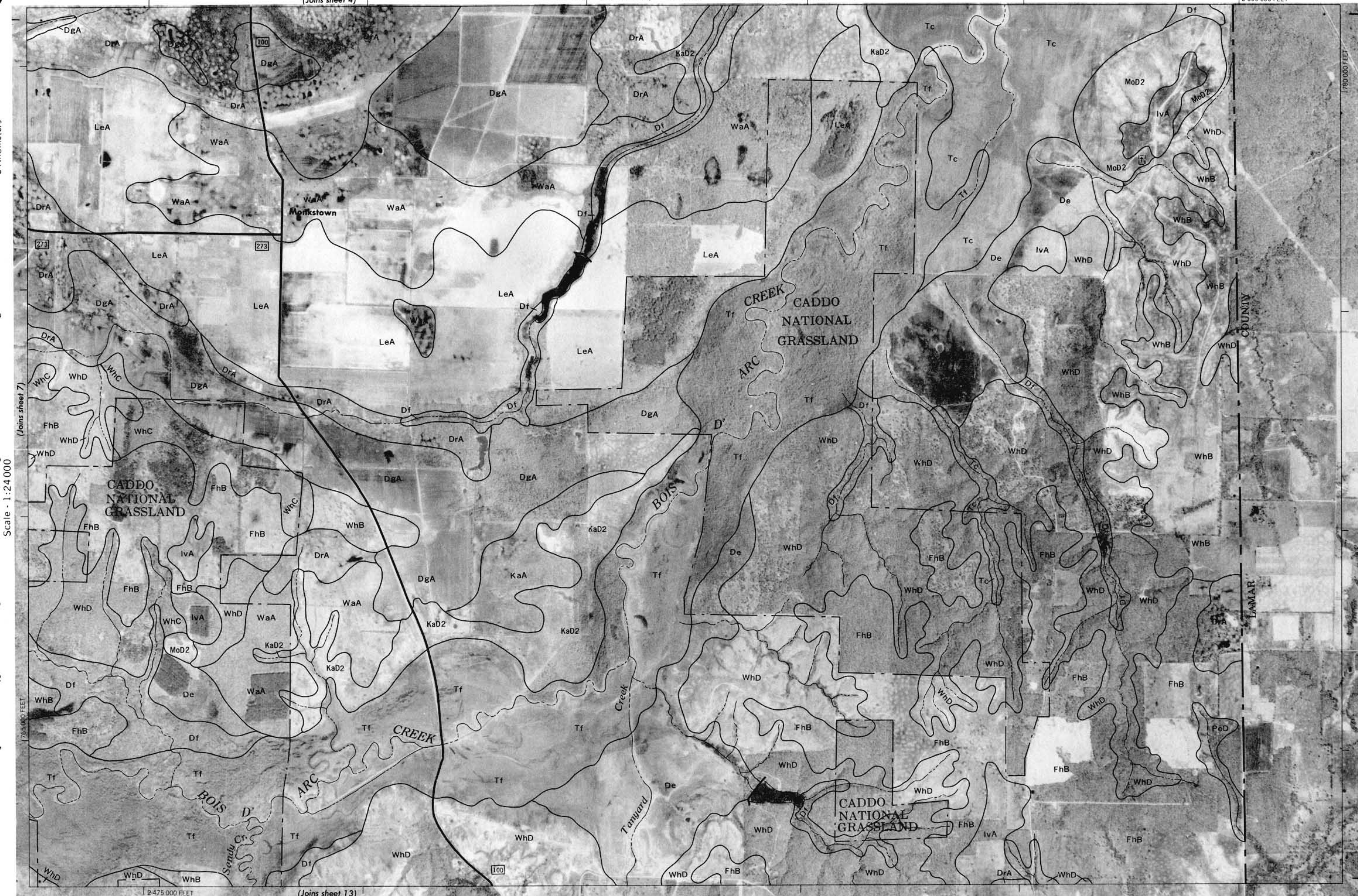
FANNIN COUNTY, TEXAS — SHEET NUMBER 8

N

Scale - 1:24 000

10 000 Feet · 5 000 · 0 · 1000 · 2000 · 3000 · 4000 · 5 000

3 Kilometers · 2 · 1 · 0 · .5 · 1



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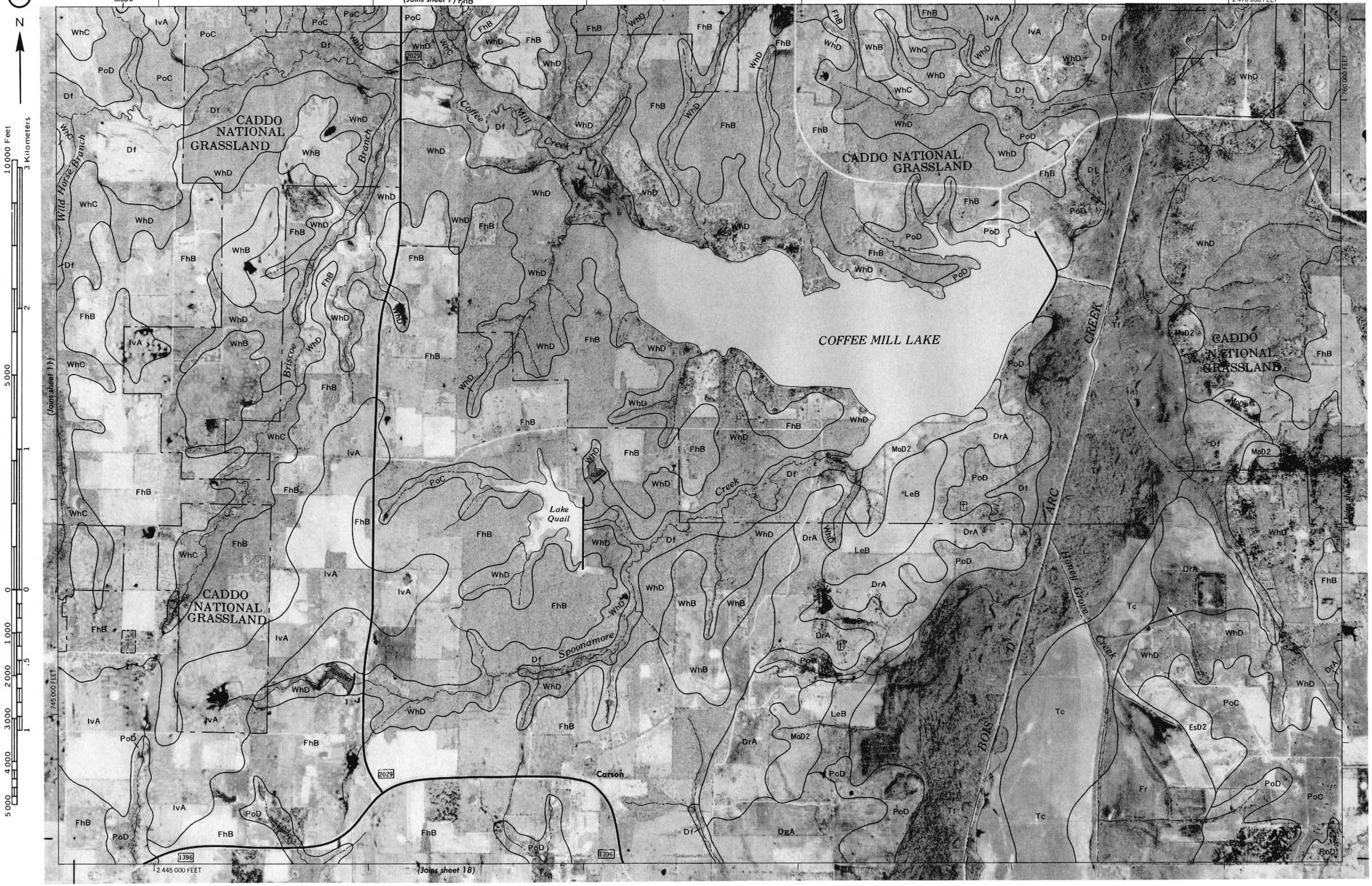

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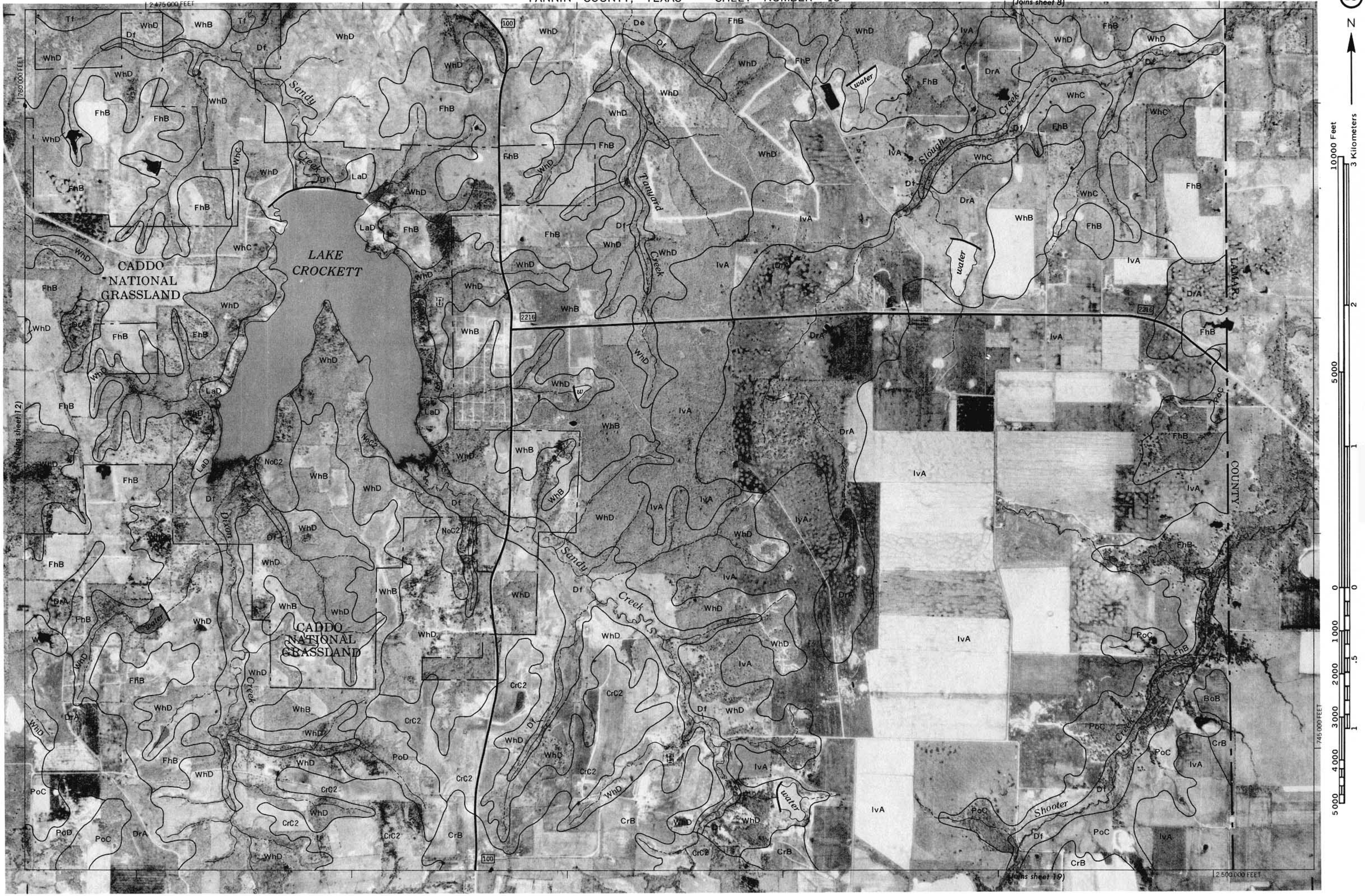

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FANNIN COUNTY, TEXAS — SHEET NUMBER 14

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FANNIN COUNTY, TEXAS — SHEET NUMBER 17

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FANNIN COUNTY, TEXAS — SHEET NUMBER 18

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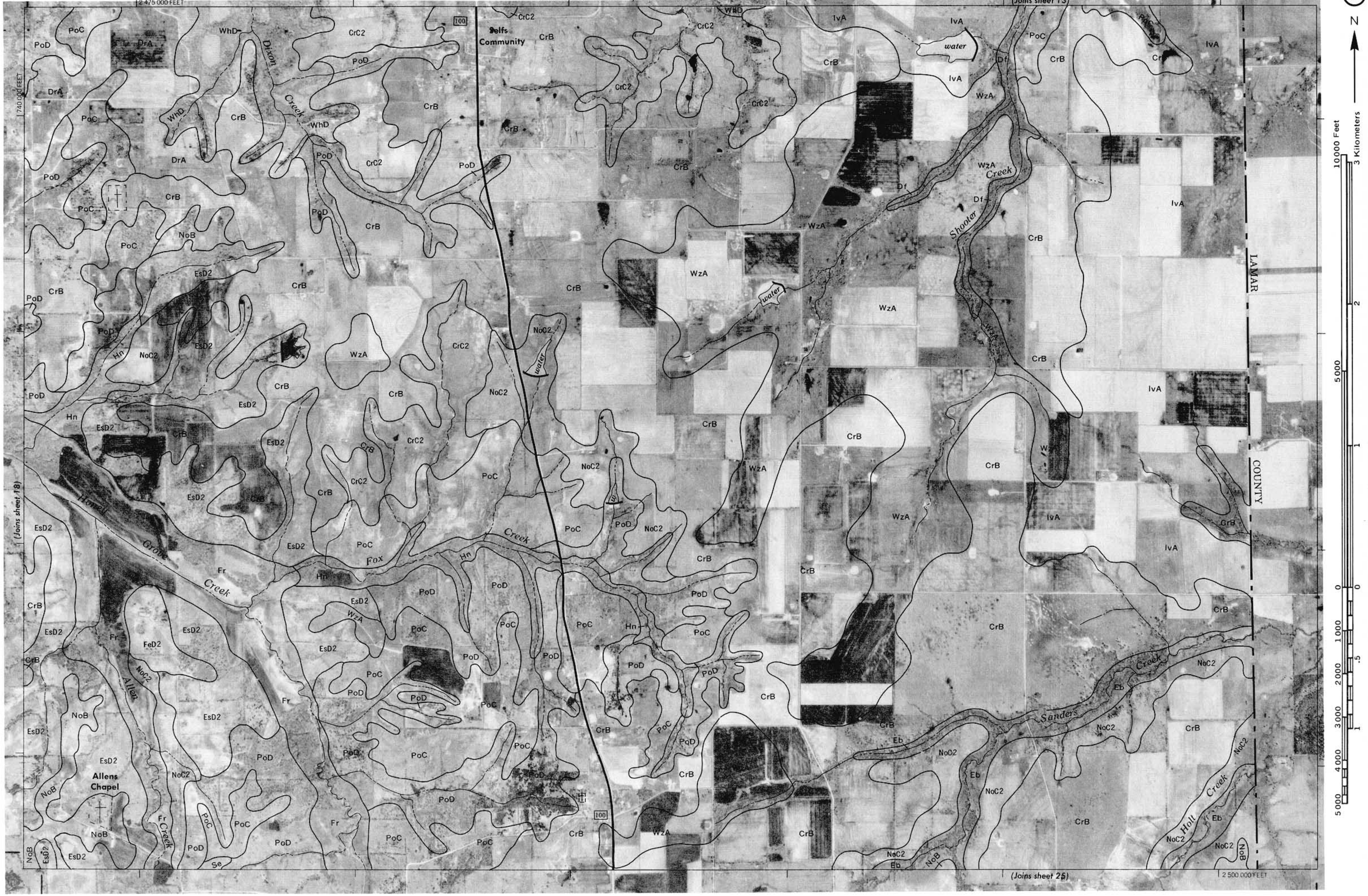

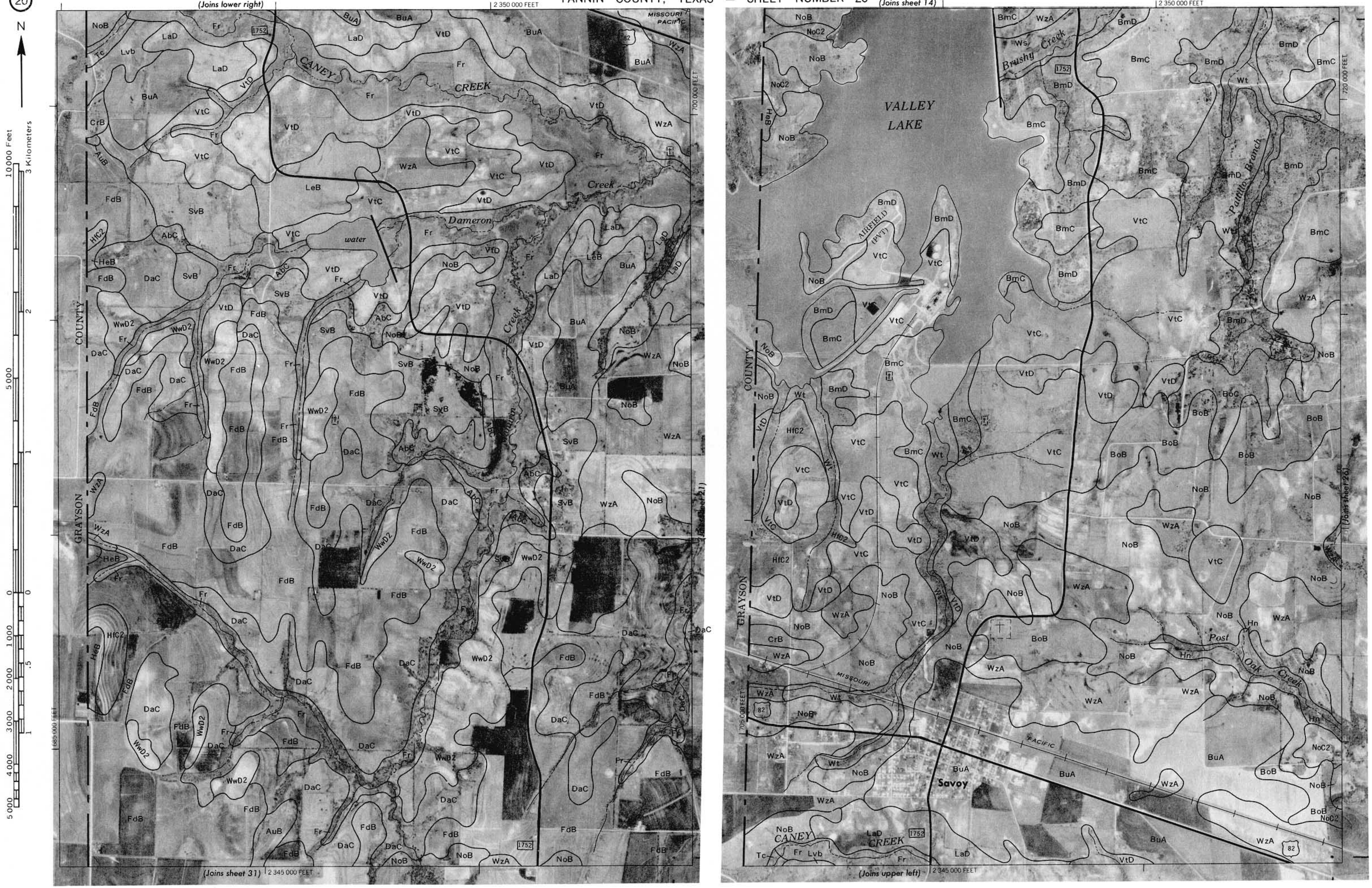

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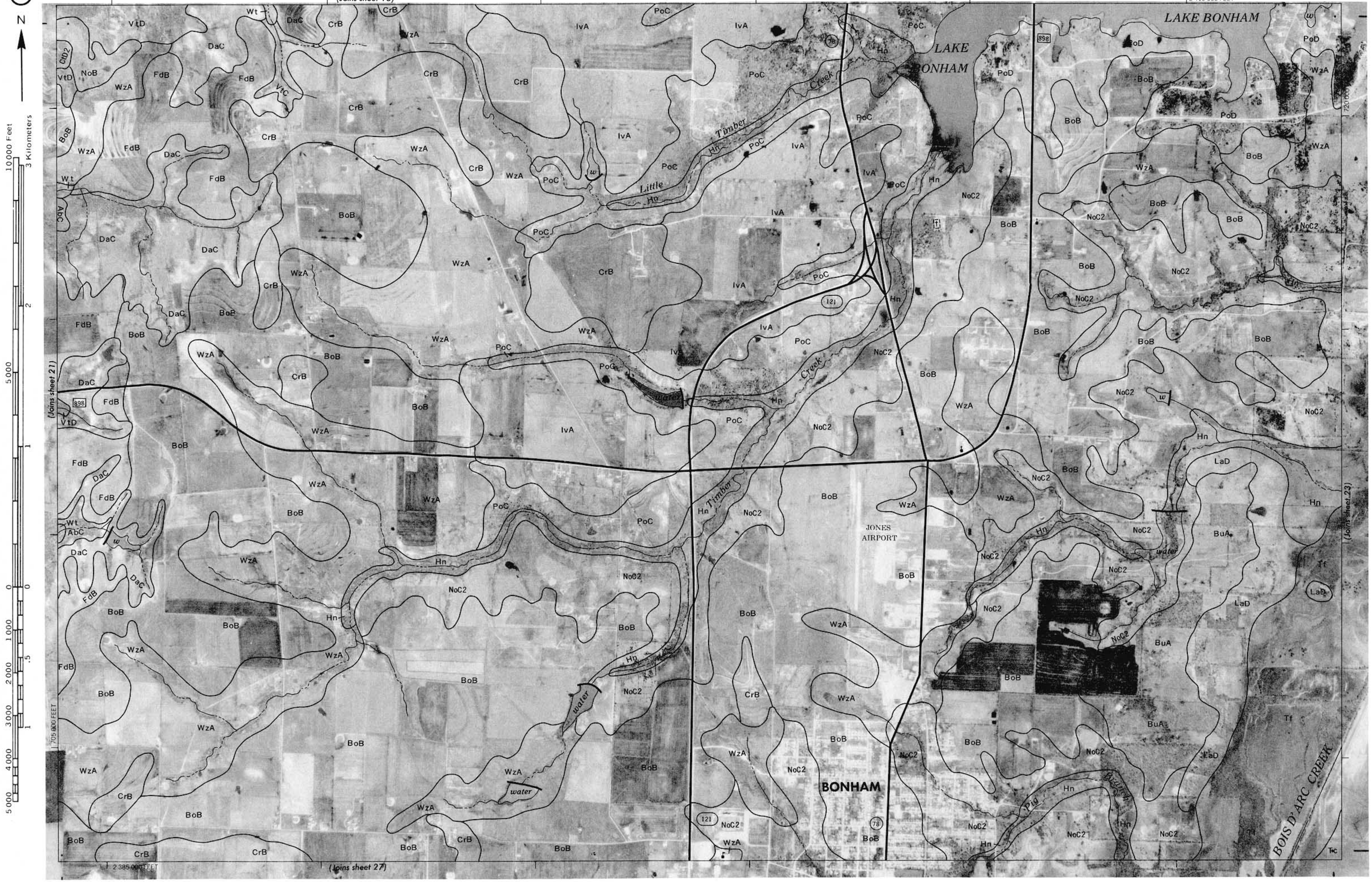

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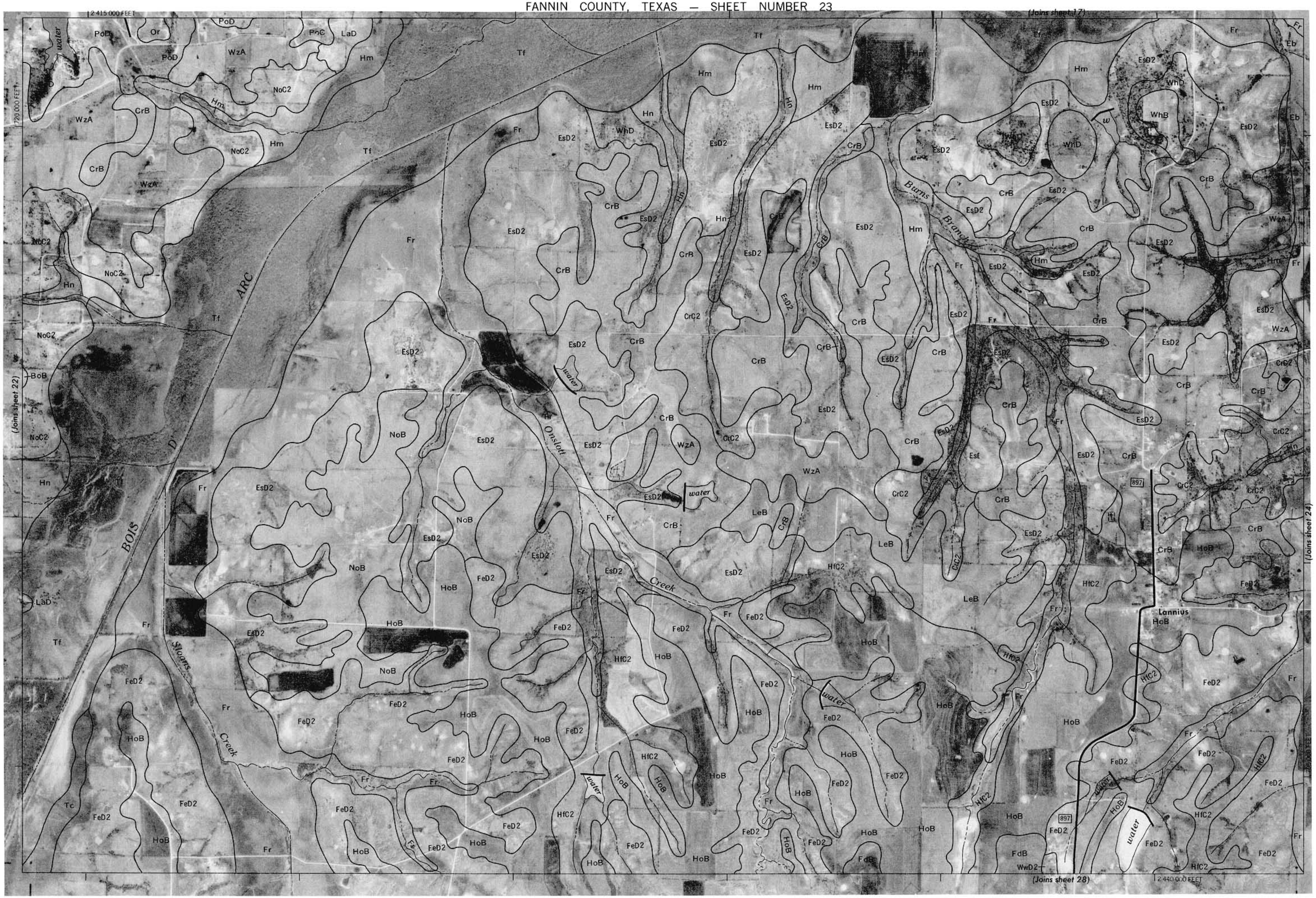

N
10000 Feet
3 Kilometers
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2
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0
.5
1

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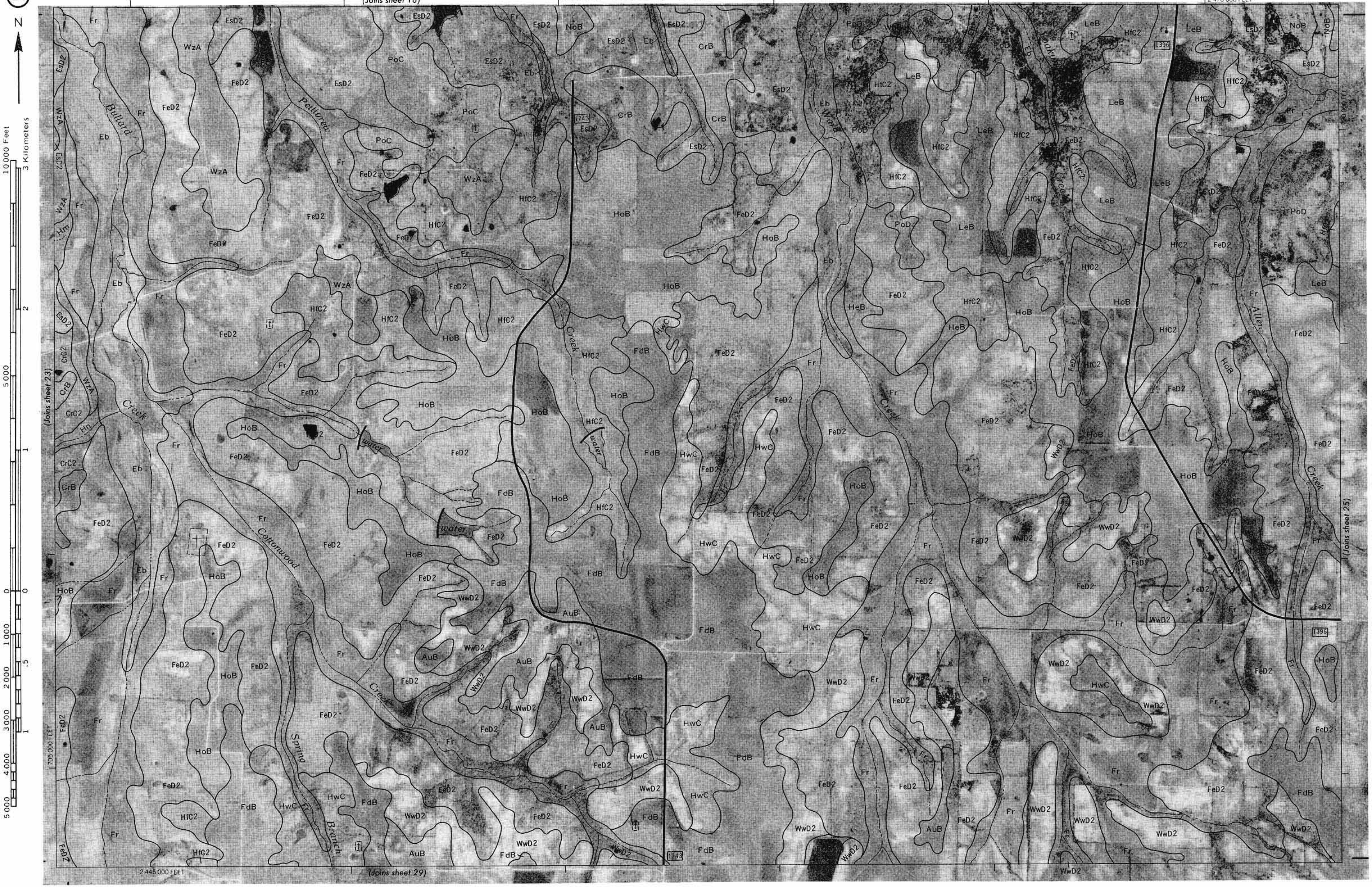

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FANNIN COUNTY, TEXAS — SHEET NUMBER 25

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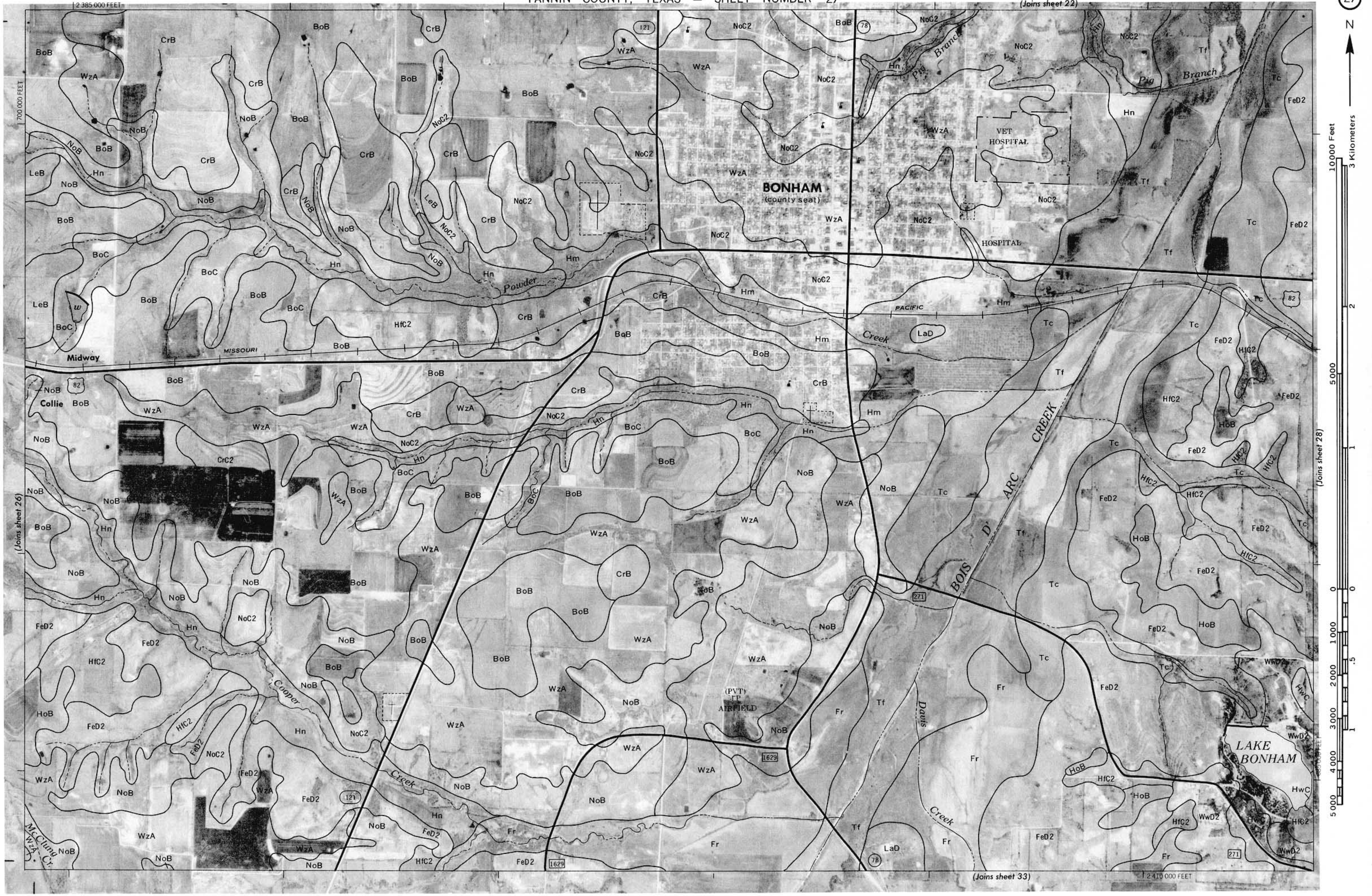

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FANNIN COUNTY, TEXAS — SHEET NUMBER 28

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FANNIN COUNTY, TEXAS — SHEET NUMBER 29

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FANNIN COUNTY, TEXAS — SHEET NUMBER 32

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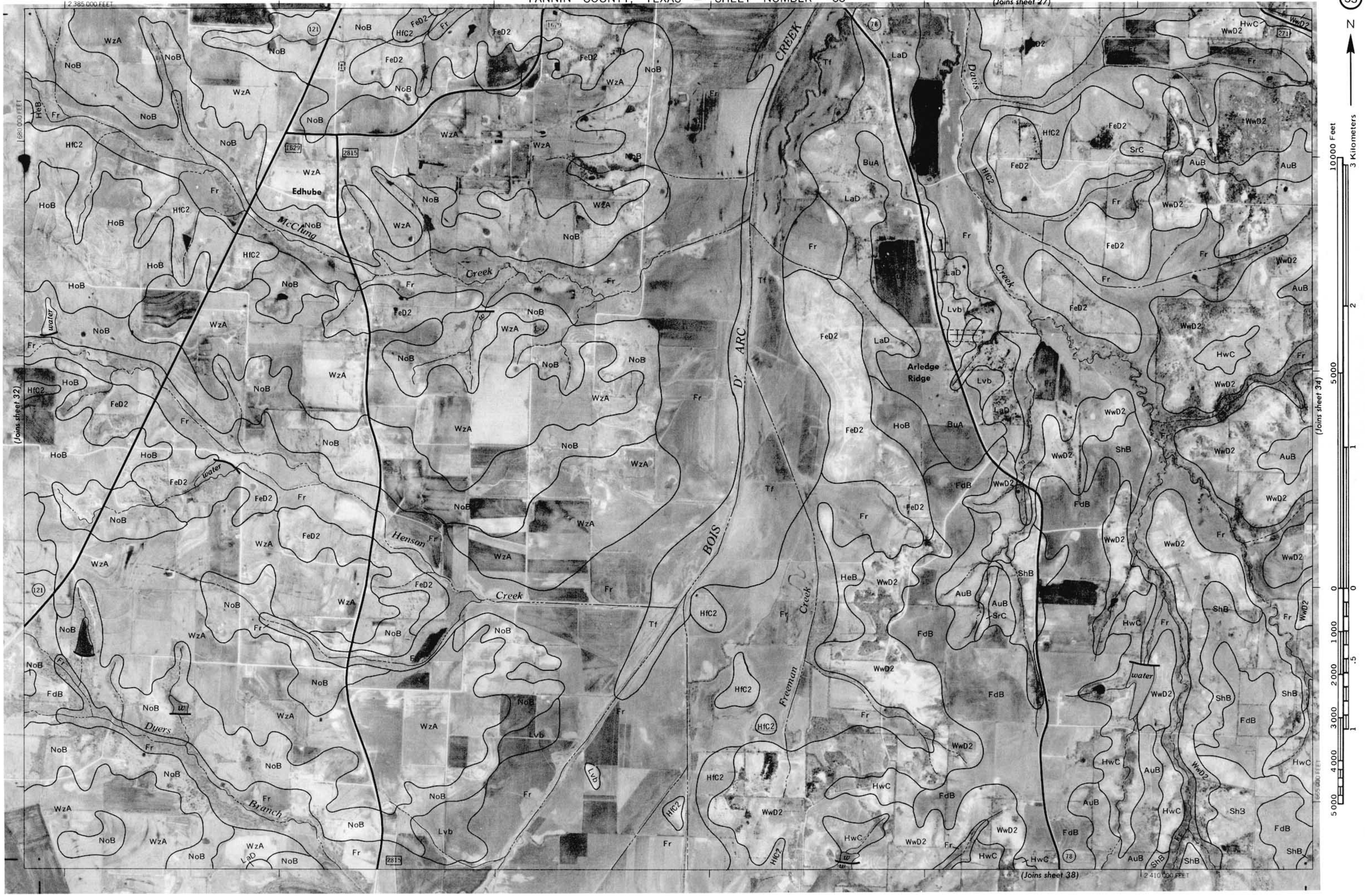

FANNIN COUNTY, TEXAS — SHEET NUMBER 34

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FANNIN COUNTY, TEXAS — SHEET NUMBER 35

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FANNIN COUNTY, TEXAS — SHEET NUMBER 36

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FANNIN COUNTY, TEXAS — SHEET NUMBER 38

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FANNIN COUNTY, TEXAS — SHEET NUMBER 39

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N
10 000 Feet
3 Kilometers
(Joins inset, sheet 31)
(Joins lower right)
(Joins upper left)
(Joins sheet 48)
(Joins sheet 43)
Trenton
Nobility
GRAYSON COUNTY
COLLIN COUNTY
Dodge Rock Creek
Pot Rock Creek
Dog Creek
Indian Creek
Bailey Creek
water
This map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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This map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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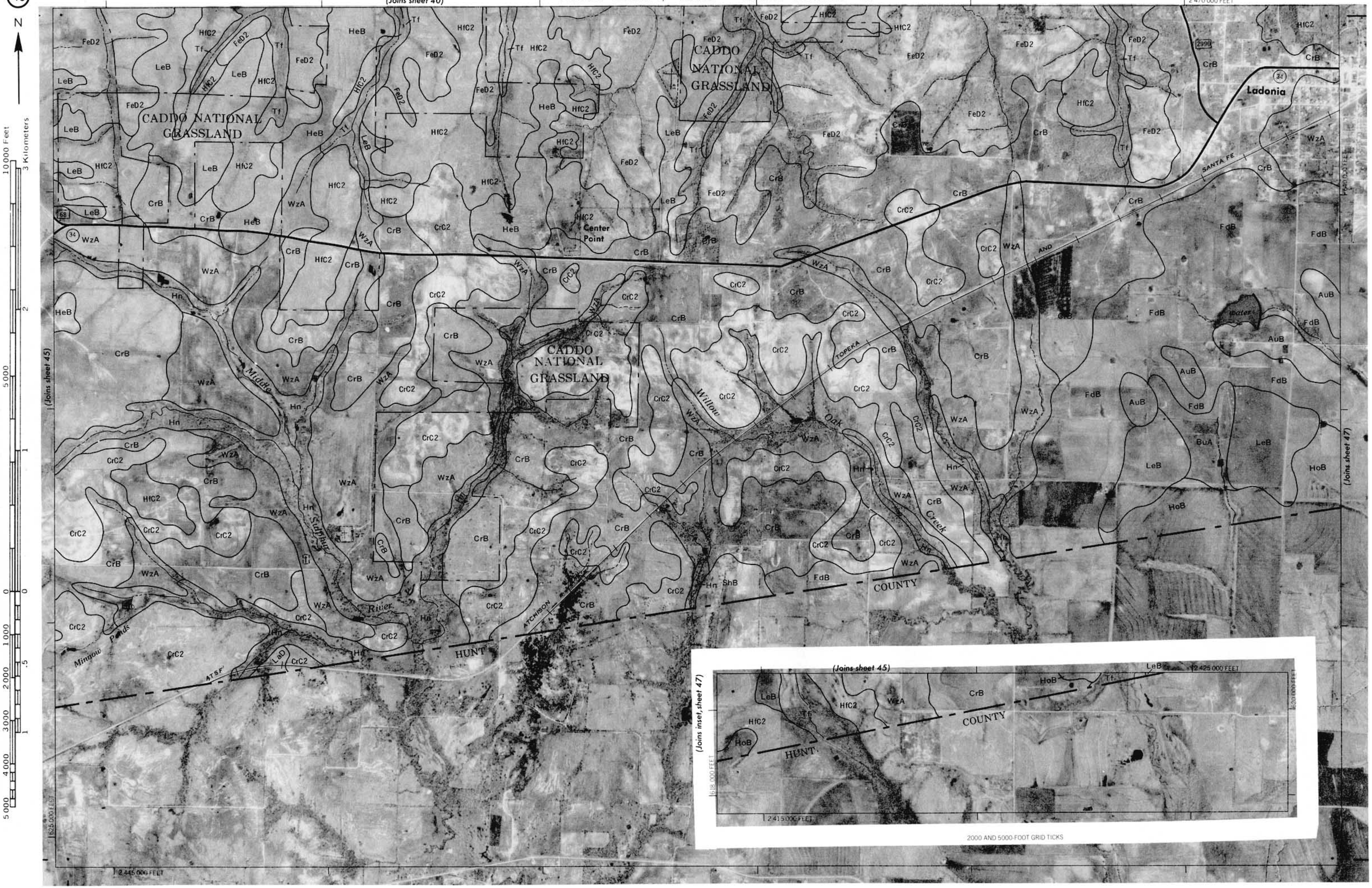
FANNIN COUNTY, TEXAS — SHEET NUMBER 45

45

This map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

FANNIN COUNTY, TEXAS — SHEET NUMBER 46



2000 AND 5000-FOOT GRID TICKS

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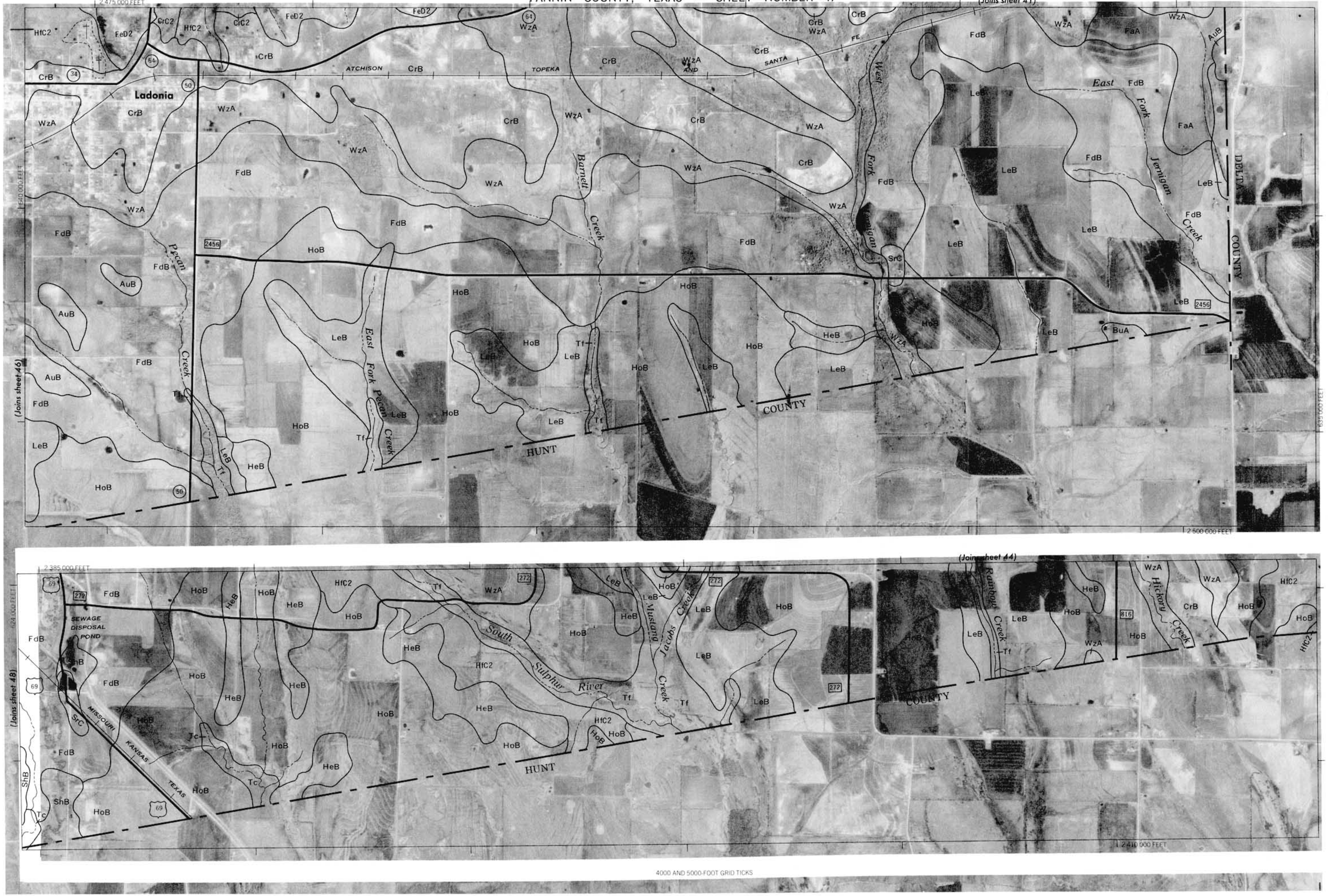

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N

10000 Feet

3 Kilometers

5000

0 1000 2000 3000 4000 5000

0 .5 1

(Joins inset, sheet 46)

4000 AND 5000-FOOT GRID TICKS

FANNIN COUNTY, TEXAS — SHEET NUMBER 48

This map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.